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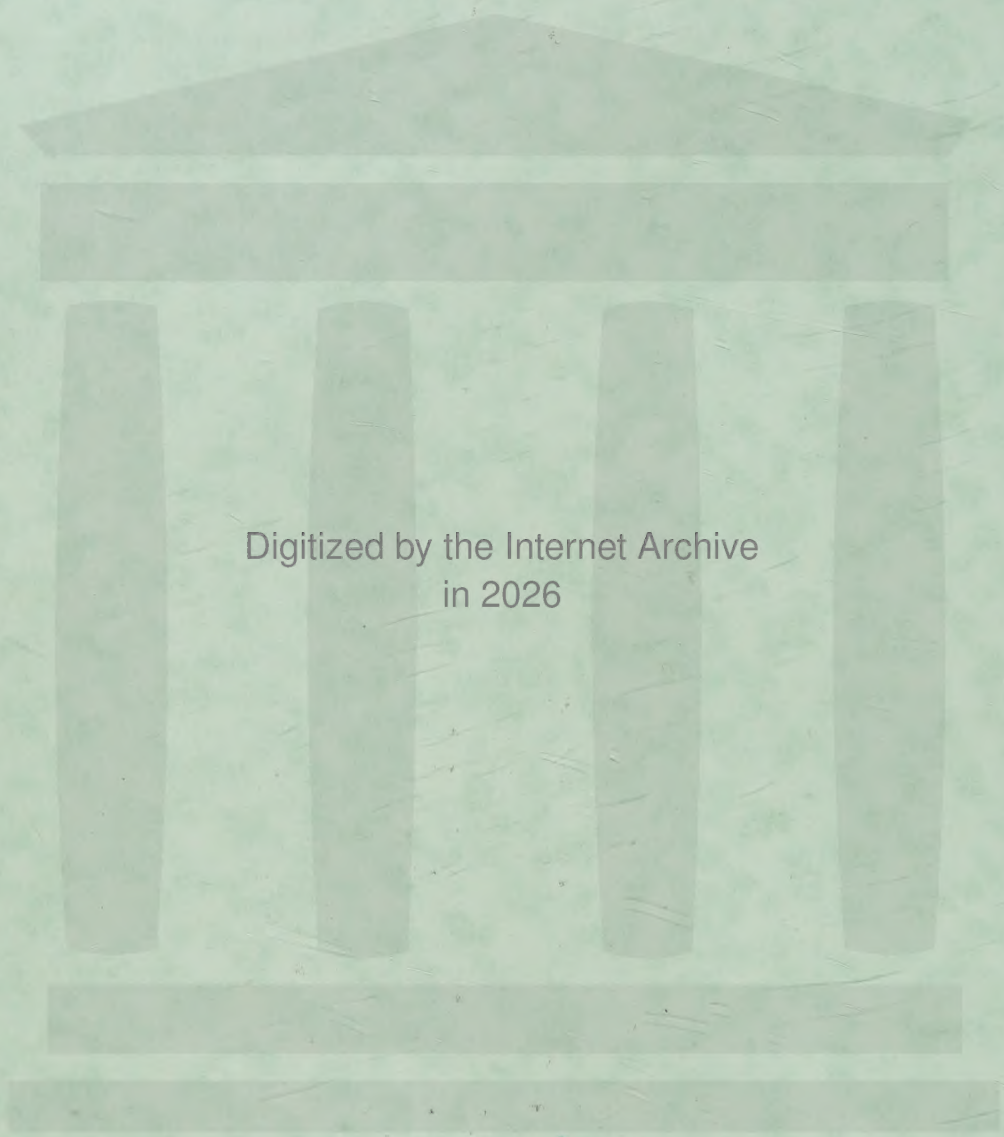

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It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note, historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs, CIMA, SIM, and ICCP, during the past six years. The Coral Atoll Program is a part of SIM.

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ATOLL RESEARCH BULLETIN

No. 31

Expedition to Raroia, Tuamotus

Part 1. Expedition to Raroia, Tuamotus

by Norman D. Newell

Part 2. Physical Characteristics of Raroia

by Norman D. Newell

Part 3. General Map of Raroia Atoll

by Norman D. Newell

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Part 1

EXPEDITION TO RAROIA, TUAMOTUS

by Norman D. Newell

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EXPEDITION TO RAROIA, TUAMOTUS [1]

by Norman D. Newell

INTRODUCTION

Preface

An intensive ecological reconnaissance of Raroia, [2] a Polynesian atoll about 450 miles northeast of Tahiti, was successfully completed during July and August, 1952, by a seven man research team representing the biological and geological sciences. This study, the third project in a program of atoll studies organized by the Pacific Science Board of the National Research Council and supported principally by contract N7-onr-291(04), NR 388-001 with the Office of Naval Research, enjoyed the active aid of the French colonial government at Tahiti, without which the study of Raroia could not have been undertaken. Funds equal to about 20 per cent of the total budget were supplied to some of the team members by The American Museum of Natural History, under a grant from the Humble Oil and Refining Company, and by the U. S. National Museum, The University of Hawaii, and Mr. George Vanderbilt.

Although splendid results were obtained, the team was handicapped by failure to receive approximately one-half of the expedition equipment, strike-bound on the eve of departure in a California port. Part of this highly specialized equipment, assembled at considerable cost over many months, was generally irreplaceable and the success of the expedition was, therefore, jeopardized. Essential items withheld from the team in this way included a boat, several rafts, outboard motors, a compound microscope, books for field determinations of corals and plants, an underwater camera, fishing gear, warfarin for studies in rat extermination, fish poison and gasoline. Without replacement of some of the most crucial of these items a comprehensive study of Raroia could not have been undertaken.

The problem of supply was difficult for the expedition because freight sailings from the United States to Tahiti are infrequent and there are none from Hawaii, where the team members were convening early in June. The expedition was reprieved by the circumstance that the Tahiti government had just purchased a small vessel which was being prepared in Honolulu for an early voyage to Papeete. Through the courtesy of H. René Petitbon, Governor of French Oceania, certain replacement items were carried on this vessel to Tahiti. These included fishing gear and poison, warfarin, special fish drums, cans and canning equipment for sea weeds, and one outboard motor. The equipment and supplies were delivered to the team on Raroia in time for use of most items but too late for use of the warfarin in the projected studies on

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1/ Pronounded Rah-ro-ee'-a

2/ Members of expedition, in addition to author, were John V. Byrne, Bengt Danielsson, Maxwell S. Doty, Robert R. Harry, J. P. E. Morrison, and W Jan Newhouse.

rats. The rat poison was returned to Papeete and turned over to the Institut de Recherches Médicales de l'Océanie Francaise for studies in Tahiti.

The selection of Raroia among the numerous atolls of French Oceania was most fortunate. The selection was made because the team anthropologist, Bengt Danielsson, had recently spent 18 months on the atoll studying acculturation of the people. He was thoroughly familiar with the language, the inhabitants, and working conditions. More important, he was assured of the complete support of the people. He was enthusiastically welcomed as an adopted son of a Raroian family and a member of the community. Having come to them, first as a member of the intrepid Kon Tiki crew, later as scholar and student of their ways, the people had acquired respect for Danielsson that amounted almost to veneration.

Because of these special circumstances the people made available to the expedition team their considerable resources including boats, outboard motors, clean cistern water, several houses, a shower bath house, a toilet, refrigerators, and all-wave radio receivers. The transportation facilities were neither adequate nor reliable, but they permitted a successful comprehensive reconnaissance of the atoll.

Cooperation of the French Administration in Tahiti

Besides supplying transportation for part of our equipment from Honolulu to Tahiti, Governor Petitbon provided round trip transportation from Papeete to Raroia on the government schooner Tamara. M. Frederick Ahnne, Administrator of the Tuamotu Archipelago, accompanied the team to Raroia to explain the government's interest in the project to the people of the atoll. The Governor arranged also for the charter of the Air Tahiti Gruman-Condor seaplane for the purpose of an aerial photographic survey of Raroia by the expedition members. The Papeete government contributed a substantial part of the charter cost so that a medical officer could visit Raroia, Hikueru and Anaa for routine examinations of the population. He also persuaded Colonel Chavat, chief of a French mapping mission, to accompany the flight to Raroia in order to assist in obtaining suitable photographs of the atoll.

The staff of the Institut de Recherches Médicales de l'Océanie Francaise, Dr. John Kessel, Dr. Georges Torres, and Mr. and Mrs. Glen Parrish, were helpful and courteous to members of the expedition. Helpful aid and counsel were freely given by many of the citizens of Papeete.

Valerie Zirkle Newell and G. Robert Adlington of The American Museum of Natural History devoted many weeks in the selection, purchase, and packaging of expedition supplies in New York, and Mrs. Newell, who preceded the research team to Tahiti, gave valuable aid there in completion of arrangements with the Government. Without Mrs. Newell's intervention it is doubtful that the difficult but urgent radio communication between Papeete and Raroia would have been finally established. Untiring efforts of the staff of the Pacific Science Board, Mr. Harold J. Coolidge, Mrs. Lenore Smith, and especially Miss Ernestine Akers, on behalf of the expedition were in large measure responsible for the successful conclusion of the field work.

Through the courtesy of Dr. Preston E. Cloud, Jr., a pH meter and a plane table, alidade, and surveying rod of the U. S. Geological Survey were made available on loan for our studies. Dr. John W. Wells identified the corals and Mr. J. Sperrazza, the Foraminifera.

Fortunately for the needs of the expedition, the people of Raroia are moderately prosperous. They live in a single village, Garumaoa[1] (Ngarumaova), situated on the lagoon near the single ship pass. The numerous facilities of the village of 127 persons were more or less continuously available to the research group. Two radio receivers monitored the Papeete programs almost continuously, so that official messages in the Tahitian language sent to us from Tahiti were promptly received and delivered. This was a valuable service during three difficult weeks before our contact with Papeete, via Hikueru, was established by means of our small hand-generated two-way radio.

The climate of Raroia is ideal and altogether the working conditions were very comfortable.

Field Operations

All direct negotiations with the people were turned over to Danielsson, who was aided by Miss Aurora Natua, a Tahitian scholar. Besides his own scientific investigations of the people, Danielsson was given charge of the medical supplies, the kitchen help, and the paying of wages. General camp policies and project plans were developed by the combined team.

Scientific activities were distributed as follows: Physical ecology of the atoll (geology) and coral distribution, Norman D. Newell, assisted by John V. Byrne; biological factors of ecology, and plant distribution, Maxwell S. Doty, assisted by Jan Newhouse; animal distribution, excepting corals and fishes, J. P. E. Morrison; fish distribution and ecology, Robert R. Harry; ethnology and human ecology, Bengt Danielsson.

The Map

The flight for aerial photographs was taken during the early morning of June 20, 1952, which luckily happened to be the only clear day of a long series of overcast days. Two 35 mm Argus C-3 cameras with K2 filter were used interchangeably for vertical views. One camera at a time was mounted in a blister replacing a side window. Bengt Danielsson and Maxwell Doty operated these two cameras, making exposures at 15 second intervals. The flight was made at an altitude of 3000 meters in order to obtain negatives of convenient scale (1:60,000) and the scale was later confirmed on the ground by plane-table traverse. Surprisingly good results were obtained in two circuits of

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1/ We have adopted standard Polynesian rather than French forms of the native names. The Polynesian g is pronounced and often spelled ng.

the atoll with nearly complete coverage (95 per cent) of the rim. In addition, oblique photographs of the lagoon show hundreds of small patch reefs many of which eventually may be approximately plotted on the map after calculating corrections for oblique perspective. The vertical photographs were printed at 1:20,000 and this scale was employed for compilation of a base map. The negatives have been filed with the Colonial Government in Papeete. The final map is Part 3 of this Bulletin.

Collaboration in Field Work

Integration of heterogeneous field data from diverse disciplines is essential in an ecological reconnaissance such as this study of Raroia. Personal bias in the collecting and evaluation of data is not easily weighed, however, and it is usually difficult for the specialist to accommodate his attention to problems outside the fringe of his personal experience. Efforts were made at Raroia to overcome these natural difficulties. Time was taken by each participant from his special tasks to accompany the other members in the field in order to establish and maintain contacts in overlapping areas of investigation and to learn about more divergent matters. There were several round-table discussions and innumerable conversations involving various combinations of personnel. In general, the smaller groups were more satisfactory for discussions than the assembled team.

Within the framework of the project a number of special studies were undertaken involving two or more collaborating members of the team. Examples are: 1) several transect surveys, 2) land tenure and copra production, 3) classification of native names of, and utilization of plants and animals, 4) native terms for geologic features, and many others.

General Results

Raroia is similar to other Tuamotuan atolls, but conspicuously unlike recently studied atolls of Micronesia (Bikini, Arno, and Onotoa). Since Polynesian atolls generally have been inadequately known, Raroia may well serve as a standard of reference for Polynesia. Great quantities of field data and specimens were obtained. These include photogrammetric data probably superior to those available for other South Pacific atolls. The collections indicate an unexpectedly rich biota comparable to those of Samoa and Bikini. Our results suggest that previous conclusions have been based on inadequate collecting. For example, 286 species of fishes have been known from all of the Tuamotus, but our collections from Raroia include approximately 400 species. Fifteen species of corals have been known previously from the Tuamotus, but our collections from Raroia contain 53 species. This work shows that very many species range much farther to the east in the Pacific than had been believed, and knowledge of the biota of the central South Pacific has been greatly expanded. Data on the people and their history are especially complete. The first results on the expedition to Raroia have been issued as Bulletin 18, Ichthyological Field Data of Raroia Atoll, Atoll Research Bulletin, 190 pp., 1953. Other reports appear in the present and subsequent numbers of the Atoll Research Bulletin.

Some Fundamental Problems of Atolls

Coral atolls, justly celebrated in a voluminous scientific literature running into tens of thousands of pages, have long attracted the fascinated attention of voyagers in tropic seas. The center of interest until recently has lain chiefly in the genesis of reef forms and the nature and origin of the central lagoon which gives atolls their most characteristic expression.

Atolls support more or less balanced marine and usually also terrestrial communities surrounded by relatively sterile waters such as characterize the plankton-poor waters of the tropics and subtropics (Sargent & Austin, 1949). The origin and economy of these relatively simple communities provide many unsolved ecological problems of the greatest fundamental importance.

Consider the difficult and complex initial colonization of a newly formed shoal area or volcanic island surrounded by deep sea. In the great eruption of Krakatau in 1883 the local island life and shaol-water organisms were largely exterminated and the area for a time was rendered uninhabitable for most species (Dammerman, 1948). Within a few weeks reinoculation by airborne and seaborne spores, seeds, larvae, and adults of hardy pioneers was begun. Colonization of Krakatau, carefully studied by Dutch biologists, seems to have followed predictable chance frequence directly related to larval hardiness, length of migratory stage, and various other factors that make up the repertory of dispersal facilities. Some species arrived early, others later, the relative time of introduction being directly related to the frequency with which colonizers of each species could successfully bridge the barrier of deep water. Only the barest outline in this complex series of events is really known. Much must still be inferred.

The colonization of a volcanic mountain like Krakatau on first consideration may appear much more complex than the colonization of a low, relatively sterile atoll. However, avoiding for the moment the involved question of the various origins of atolls, it is generally agreed that many atolls undoubtedly did originate through the gradual sinking of reef-encircled volcanic mountains. The biota of such atolls, in a sense, are in some quarters considered relicts derived from the ancestral high islands, restricted and modified by relatively homogeneous and almost monotonous ecologic conditions. The ecologic simplicity of atolls makes them especially attractive to those who would try to understand the interrelationships and processes among the organisms of a primitive sea-land community. This simplicity, however, is only apparent and misleading. Most of the ecologic problems of atolls are indeed poorly understood.

The ecologic interrelationships between coralline and other kinds of algae on the one hand and the coral animals so characteristic of tropical reefs are not understood. The intimate and almost universal association in reefs of these specialized plants and animals strongly suggests that they may be interdependent. Reef-building (hermatypic) corals invariably contain in their tissues zooxanthellae, unicellular algal symbionts, which aid the corals by utilization of animal waste and by secretion of oxygen. However, many corals may feed exclusively on animal plankton (Yonge, 1940), which in turn must feed on phytoplankton. Sargent & Austin (1949) have determined that the quantity of plankton swept across the reefs of the northern Marshalls by wind-driven

currents is grossly inadequate to support the reef animals. They conclude, therefore, that the reefs are self-supporting; that is, the reef algae produce at least as much organic matter as consumed by the reef animals, and that the rate of production of organic matter by an atoll as a whole is several times as high as that of the surrounding ocean. Rather than filtering plankton, the marine community of the atoll, according to these investigators, absorbs inorganic nutrients from the passing equatorial current (Sargent & Austin, 1949, pp. 245-249).

Surface tropical waters in midocean are classically considered deficient in nutrient salts. The situation over deep waters near coral reefs has not been sufficiently investigated, but it seems probable that turbulence extends to considerable depth where coral reefs are bathed in the equatorial currents and this turbulence would certainly bring nutrient rich deeper waters to the surface. Orr (1933, p. 62) found evidence of upwelling along the Great Barrier reef. This might well be most pronounced during rough weather when adequate observations have not been made.

Coral animals, as well as coralline algae, generally are most productive at the outer margins of seaward reefs. This growth vigor on the seaward side, according to Yonge (1940, p. 332) is most probably related to the greater transparency of the water there as compared to the lagoon which allows photosynthesis of zooxanthellae and coralline algae to extend to maximum depths. He considers this factor more important than greater supplies of oxygen and animal plankton at the outer reef edge. This matter requires further study.

It is a matter of considerable interest that a low bank of coral gravel thrown up above high tide level by a storm very quickly supports a characteristic varied assemblage of higher plants without the development of humus and a soil profile. Coconuts germinate and become healthy trees in apparently sterile gravel. It has been demonstrated that several kinds of algae fix nitrogen from the air. Some of these (Myxophyta) grow better on an alkaline substratum than elsewhere. Algae aided by bacteria fix nitrogen better than do the bacteria alone (Chapman, 1941, p. 304). It may be considered as probable that the fertility of newly exposed accumulations of coral gravel and sand is to a large extent a result of the activities of nitrogen-fixing algae and bacteria having a range of osmotic tolerance such as characterizes the flora of the littoral zone. Some of these very likely are normal inhabitants of the sea. Sea birds, which rest on rocks and gravel bars, precede the terrestrial vegetation and enrich the ground with fertilizer gathered over a wide radius of open sea. Investigations into the colonization and productivity of atolls, along these and other lines, promise to yield significant results. Hatheway (Atoll Research Bulletin 16) has emphasized the relationship between atoll vegetation and variations in the bird populations and phosphate concentrations in the soil.

Coral atolls are enormous accumulations of calcium carbonate. Interest in the conditions of origin of limestones has greatly stimulated the investigation by geologists of calcium carbonate in modern seas. In most areas of the sea floor at the present time and during the geologic past calcareous material has been predominantly in the form of skeletal structures of animals and plants, hence, the sedimentationist, the paleontologist and the marine biologist are all directly concerned with the problem of formation of such sediments.

Calcium carbonate is also precipitated directly from sea water to form inorganic muds and sands (Newell, et al., 1951). Although the problem has been under study for many years, final conclusions cannot be reached regarding the relative importance of inorganic precipitation because the solubility of calcium carbonate in sea water is not well understood.

Surveys by many investigators (Trask, 1937), show that the calcium carbonate content of modern marine sediments is greatest at low latitudes. This is related certainly to the higher production of calcareous animals and plants in warm waters, and to the fact that warm marine waters often are supersaturated with calcium carbonate. It is well known that animals with calcareous skeletons, such as corals, mollusks and foraminifera, can extract lime from unsaturated waters, but the exact manner in which this is done is not fully understood. In any case, the secretion of lime by these organisms is enormously greater in warm, shallow seas where the waters are supersaturated with respect to calcium carbonate. In the case of lime-secreting algae, extraction of carbon dioxide during photosynthesis causes concentration of carbonate ions and precipitation of lime. Heating of the water and concentration due to evaporation will also cause precipitation of calcium carbonate from sea water, particularly when the water is agitated.

The coral reefs of the South Pacific are among the chief areas of calcium carbonate deposition of the world. It is no doubt significant that these, like other important areas of lime accumulation in the Atlantic and Indian Oceans, are bathed by warm equatorial currents (Fig. 1) probably supersaturated with respect to calcium carbonate. It is highly probable that deposition of lime sediments in all of these areas would be greatly diminished or even negligible without a "conveyor belt" source of supply.

Regional Setting of the Tuamotu Archipelago

General introduction.-Lying near the center of the Pacific Ocean the Tuamotu Archipelago is exceptionally isolated from both eastern and western continents. The atolls of this group are outposts at the southeastern fringe of the great Indo-Pacific biological realm, separated from the Americas by the most effective water barrier on earth to migrations of shallow marine and terrestrial organisms, the broad and uninterrupted deep waters of the eastern Pacific (Fig. 2). The biota of the Tuamotu is an attenuated Indo-Pacific [1/] assemblage having little in common with that of the Americas (Ekman, 1953, p. 72). It was derived mainly from the west, partly by innumerable island jumps and perhaps via the equatorial counter current (Fig. 1) and other occasional drifts opposed to the prevalent westerly circulation at these low latitudes.

Most of the Polynesian islands are oceanic in the sense that they lie well inside the andesite line (Fig. 2) which is rather generally held by geologists to form the structural margin of the Pacific Ocean.

1/ Locally, as at Clipperton Islands, less than 700 miles from Mexico, Indo-Pacific elements have successfully crossed most of the eastern Pacific without really obtaining a foothold along the Americas (Hertlein and Emerson, 1953).

Many geologists now favor the view that the continents are gradually expanding by successive orogenies at the expense of the ocean basins. Implicit in this view, the island arcs of the western Pacific rather than representing old and collapsed areas are late increments welded to the Austral-Asiatic continent.

Next to the Maldives the Tuamotu Archipelago contains the greatest number of atolls, spread in a broad belt two hundred miles wide and more than a thousand miles long from northwest to southeast. The 78 islands of the Archipelago of which 76 are atolls are arranged in several linear series reminiscent of island arcs (Fig. 3). The distribution and proximity of these atolls to the volcanic Society Islands, which ideally illustrate the successive stages in Darwin's theory of subsidence, encourage the view that the Tuamotu atolls rest on chains of volcanic mountains which have sunk beneath the sea so slowly that the reef growth has been successfully maintained near the surface. This is not the same as Stearns (1946) suggestion that the reefs of low islands were formed in shallow water on the crests of submarine folds.1/

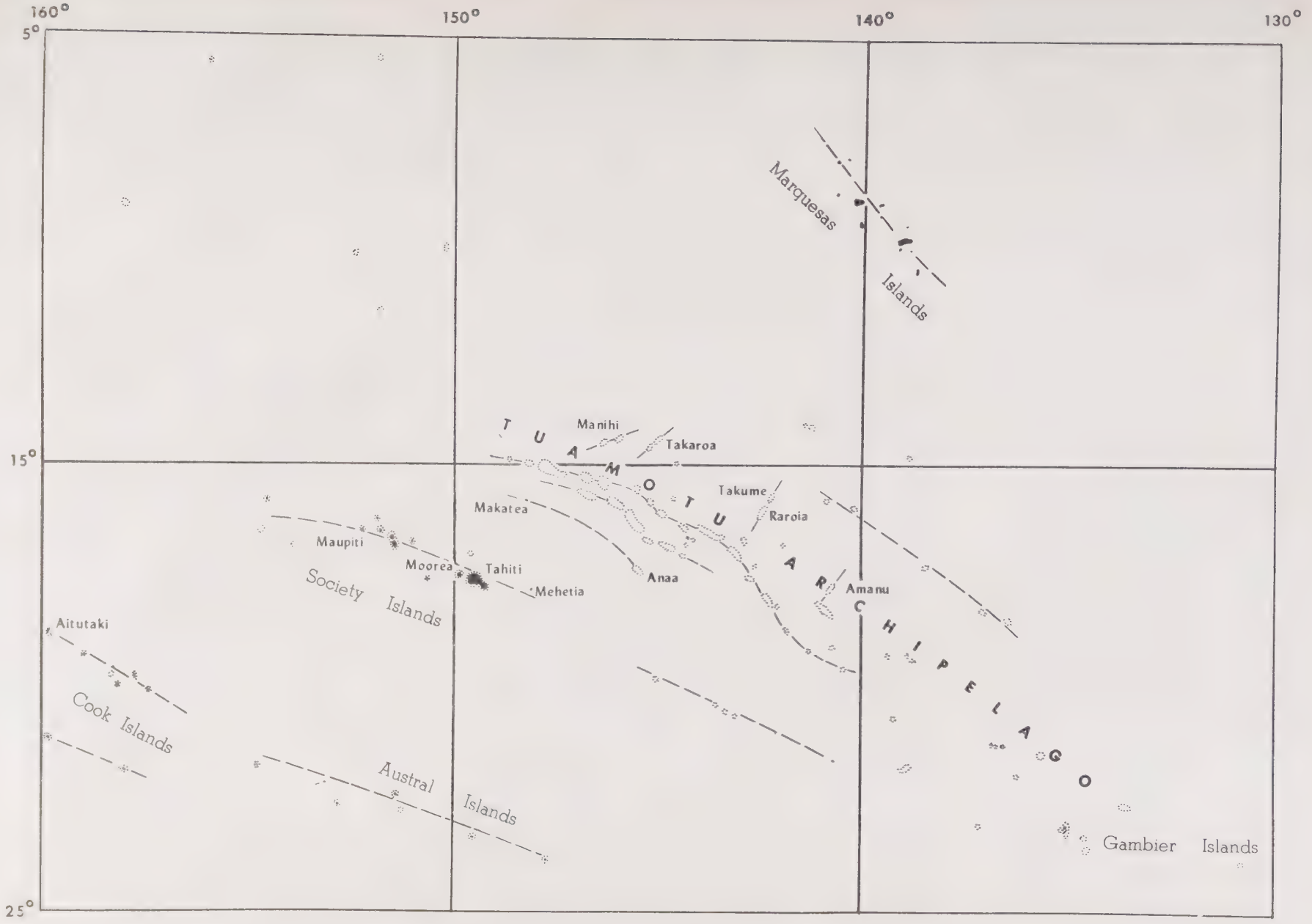
There are rather striking features that characterize most of the Tuamotu atolls and Raroia is in most respects typical of the group. The regional trend of islands in the south central Pacific is from southeast to northwest, but a few of the atolls along the northeast side of the archipelago, including Raroia, are elongate toward the northeast, at right angles to the regional trend. The prevailing currents in this area are also from the northeast. However, since there is no correspondence of form with current directions in most of the atolls, it seems safe to conclude that the northeast trend of Raroia and a few other atolls reflects structural conditions of the basement divergent from the regional trend.

The configuration of the sea floor around the Tuamotu group is very poorly known. A few soundings taken by the Albatross suggest that the northwestern atolls of the archipelago rise from a platform about 800 fathoms beneath the surface. Soundings around the central and eastern atolls indicate smaller plateaus or spurs uniting adjoining islands and show that the eastern atolls are separated by channels of great depths (Agassiz, 1903, p. xxviii).

1/ Kuenen (1947) points out that the postulated folds would all have to rise to about the same critical level of reef growth near the surface, an extremely unlikely coincidence. Following Daly's conclusion (1910) that all pre-Pleistocene reefs were killed and destroyed during low water levels of the Pleistocene Kuenen argues that solution, rather than mechanical destruction, may have reduced many limestone banks and islands to the temporary low water levels. I am inclined to believe, that only the smallest limestone islands were truncated during Pleistocene lows. For example, there are innumerable small limestone cays and islands in the Bahamas, B.W.I., which were terraced during Pleistocene low levels, but the general forms of the islands were not much affected. Terraces cut at this time are rarely more than a half mile wide (e.g. Newell, et al., 1951). Most likely the Pleistocene low levels resulted in some denudation of exposed surfaces, but there is no compelling evidence for extensive marine planation during the short duration of the low levels. Evidently the reef organisms were not eliminated but they were maintained near the level of the fluctuating sea. Of course, this argument does not affect the possibility that some atolls may lie over submerged guyots (see Hamilton, 1953).

1. Map of Pacific Ocean showing relationship of equatorial currents to the Tuamotus and other island groups.

2. Map of Pacific Ocean showing andesite line and Eastern Pacific barrier to animal and plant migrations.



3. Structure lines in part of the South Pacific.

The bottom deposits in the deep parts of the ocean (1700 to 2500 fathoms) separating the groups of Tuamotu atolls are predominantly red clay. In shallower waters pteropod and coral sandy ooze is the principal sediment (Op. cit., p. xvii). Soundings near the atolls show steep slopes characteristic of atolls (Op. cit., p. xxix).

Several observers have recognized elevated reef limestone in some of the atolls at the northwest end of the archipelago. From this evidence Agassiz has concluded that Makatea, which is somewhat dissected, was uplifted almost 230 feet (Agassiz, op. cit., p. 20), Matahiva, 10 to 12 feet (Op. cit., p. 55), Tikahau, several feet (Op. cit., p. 52), Rangiroa, 15 to 16 feet (Op. cit., p. 20), Kaukura, 17 feet (Op. cit., p. 17), and Niau, 20 feet (Op. cit., p. 20). In addition might be cited elevated coral reef limestone examined by us on Anaa, which rises at least 18 feet above low water, near the village, along the northern shore of the atoll.

Evidence of appreciable and uneven recent uplift throughout the northwestern part of the Tuamotus is well established. Agassiz's observations bearing on uplift farther to the southeast must be taken with reservations because he frequently mistook large reef blocks thrown up by storms and welded to the reef flat as erosion remnants of once higher platforms.1/ Dana had earlier correctly interpreted these as erratic reef blocks (Dana, 1890, pp. 179-180).

As pointed out long ago by both Dana (1890) and Agassiz (1903) the Tuamotu atolls are characterized by a narrow rim and by relatively few and narrow ship passes. Of the 76 atolls of the group 47 are without a ship pass, 21 have a single pass, and 10 are each provided with two ship passes (Carte de la Marine, No. 1716). The passes mark gaps in the atoll rim where organic accretions evidently have not kept pace with the general upward growth during subsidence. The majority of the passes occur approximately on the leeward side (Fig. 4). This suggests that the distribution of passes may in some way be controlled by the prevailing winds. Production and deposition of calcium carbonate sediments apparently is greatest on the windward side of Raroia atoll since the deepest part of the lagoon is downwind from the center. Early gaps along the windward rim doubtless were filled before those of the leeward rim. Possibly the flow of waters through the leeward passes, especially concentrated at ebb tide,

1/ In general, Agassiz's work on coral reefs is poorly documented and strongly colored by his crusade for the view expressed by Semper (1863) that subsidence is not involved in the origin of atolls. Many of Agassiz's assertions, such as the prevalence of outcrops of basaltic rocks on barrier reefs in the Society Islands, lack documentation and subsequent confirmation. His general explanation of the origin of the Tuamotus seems fantastic. "In the Tuamotus there is a great development of Tertiary coralliferous limestone, the last remnants of the former elevated land once covering a large area of the atolls as found also in the Gilberts" (Op. cit., p. xvii). "It is to the cutting down of the elevations of the old ledge to the general level, and the subsequent building up of the atolls by the material supplied from the reef flats and from the coral slopes that is due the great uniformity of all these atolls" (Op. cit., p. 13). This casual dating of elevated limestones of Tuamotu atolls was based entirely on supposed lithologic resemblances to certain Tertiary limestones of Fiji (Agassiz, op. cit., p. 18).

inhibits growth of corals and coralline algae, but the particular factors involved are not clearly understood.

Climate.-The Tuamotu Archipelago lies within the belt of southeast trade winds and enjoys a mild and equable climate. Danielsson (1951) reports dominantly easterly winds 1/ at Raroia with a maximum velocity in 1950 of 7 (Beaufort). There were 37 calm days in 1950. The mean diurnal high temperature in 1950 was 30.4° C and the mean low 23.3°C, giving an average of 26.8°C. The rainfall for that year was 1181 millimeters. Out of the entire year 215 days were clear (Danielsson, 1951). According to the inhabitants of Raroia, 1950 was not an exceptional year. However, Danielsson does not record westerly winds such as are supposed to occur during the rainy season (Sailing directions, Pacific Islands, vol. 2, Eastern groups, 1940, Publ. 166, U. S. Hydrographic Office).

Currents.-In accordance with the Coriolis effect the circulation of surface waters in the Tuamotus moved along by the southeast trades is usually toward the southwest at rates ranging from five to 25 miles a day. "In the rainy season, from October to March, when westerly winds, squalls, and rains are frequent, the currents vary most and occasionally set to the eastward at rates from one-half to two knots." (Saling directions, Pacific Islands, vol. 2, Eastern groups, 1940, Publ. 166, U. S. Hydrographic Office).

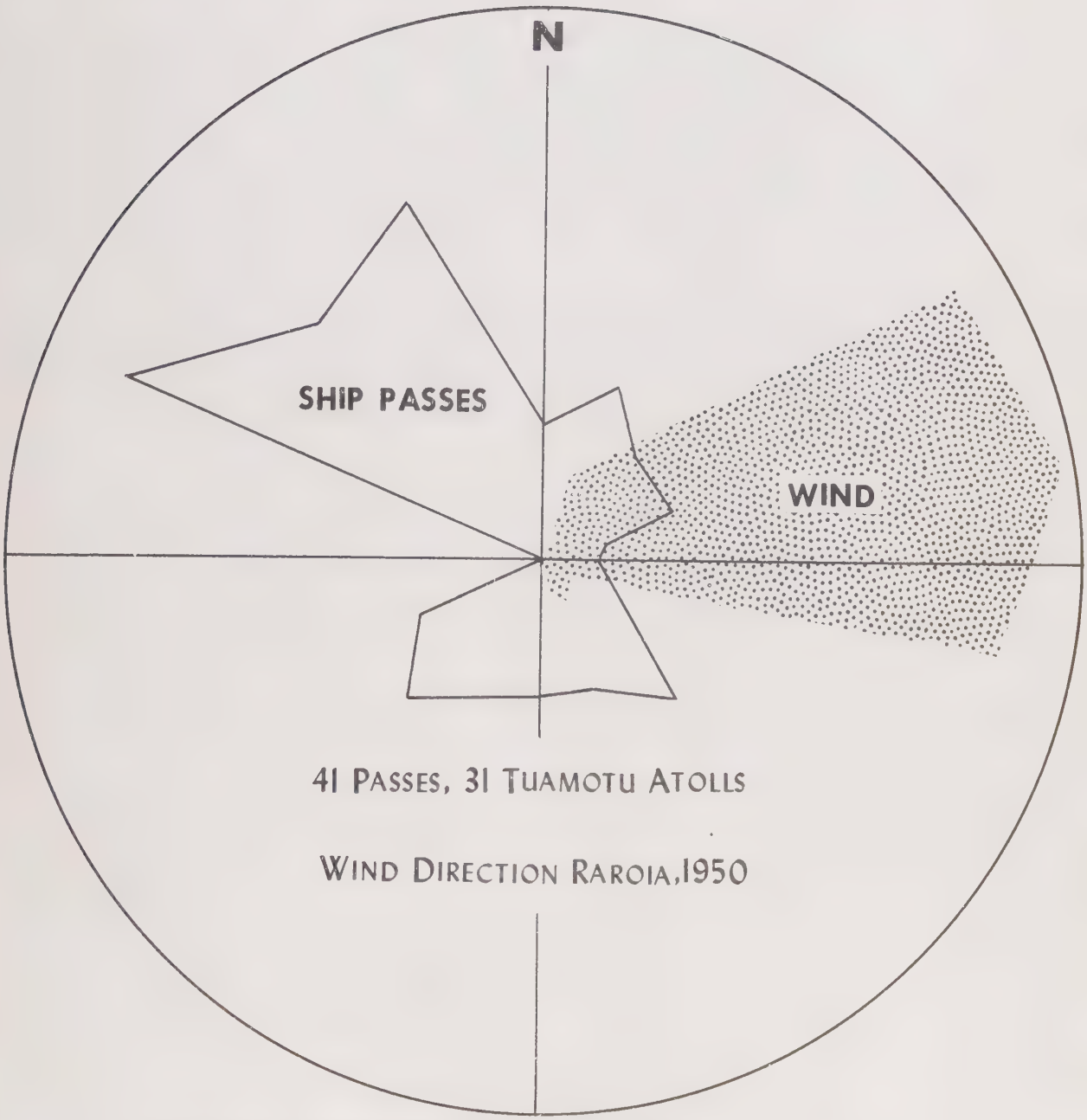
Dispersal of larvae of shallow-water animals toward the east may be largely accomplished at these times.

Southern swell.-Atolls of the Tuamotus are pounded on the south and southwest by a strong swell which produces continuous surf usually heavier than that of the windward side. The south margin of the rim in many of the atolls is relatively broad, low, and free from islets, characteristics which result apparently from the exceptionally vigorous and continuous sheet flow of water across this sector.

"The effect of the prevalent southwesterly gales in high southern latitudes in transmitting the heavy sea, which is felt many hundreds of miles from the latitudes of its origin, occasions a serious obstacle to landing on these low islands by rolling in on the shore in an opposite direction to the trade wind, making it often more dangerous to land on the lee than on the weather side of the islands." (Sailing directions, Pacific Islands, vol. 2, Eastern groups, 1940, Publ. 166, U. S. Hydrographic Office).

Hurricanes and tsunami.-According to native tradition violent storms have played an important part in modification of Tuamotuan atolls and this is abundantly confirmed by the physical characteristics of the islands. According to the Raroians winds of hurricane velocities that occasionally strike Raroia and neighboring Takume generally blow from the northwest, ordinarily the lee side of the atolls. These and many of the Tuamotu atolls have the highest and most extensive land, the coarsest coral rubble, and the largest displaced reef blocks on the lee side.

1/ Wind directions given by Danielsson (personal communication) were uncorrected for magnetic declination. The declination at Raroia for 1950, when his observations were made, was approximately 12° 02' east.



4. Relationship between ship passes and prevailing winds in the Tuamotus.

The actual frequency of tropical cyclones in these waters is unknown, but there are published records of seven severe hurricanes in the Tuamotus between 1878 and 1906. There are also less well substantiated accounts of a hurricane in 1823 and another in the 1850's. The latest hurricane, of minor consequence, touched Raroia in 1926. The wind of this storm is said to have blown from the southeast quarter at Raroia.

During the storm of 1903, still clearly recalled by many inhabitants at Raroia, sea waves were 40 feet high at the outer reef and water was higher than the house tops at the village. Opposing waves are said to have swept over the highest land from both sea and lagoon, meeting within the islands. Topographic forms of the islands, including conspicuous flow-lines in the coarse coral rubble, generally at right angles to the atoll rim strongly suggest that the land has been inundated many times, indeed built up in places, by translation waves that sweep across the atoll rim to the lagoon.

Native traditions refer to tsunami, but apparently these had but little geological significance in the Tuamotus. The latest occurrence was on April 1, 1946, when the water of the lagoon at Raroia rose some two feet above the level of spring highs flooding the village, Garumaoa, to a depth of about one foot.

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Part 2

PHYSICAL CHARACTERISTICS OF RAROIA

by Norman D. Newell

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PHYSICAL CHARACTERISTICS OF RAROIA

by Norman D. Newell

General Introduction

According to a survey of Raroia and Takume, made in 1950 by the Service Hydrographique (L. V. Nay), Raroia lies between 15° 55' and 16° 14' south latitude and 142° 18' and 142° 32' west longitude. It is elliptical with the long dimension toward the northeast. In size it is intermediate among the atolls of the Tuamotus with dimensions of 14.4 km by 44 km. The most obvious features of Raroia are a relatively large proportion of land surface to water along the rim and a large number of shallow, narrow channels, many of which are storm spillways, incomplete at the seaward end. The land surface is low, rarely exceeding four meters above normal high water[1/], and for the most part the surface is less than one meter high. The normal tidal fluctuation is small, about one-half meter, attaining perhaps one meter at spring tides; hence wind direction and velocity influence the water level far more than do the tidal fluctuations.

Raroia, like many other Tuamotuan atolls (Fig. 5) has a single ship pass on the leeward side of the atoll. The lagoon waters are clear, and relatively deep (55 m) in the center. Neighboring Takume on the other hand, and several other atolls of the Tuamotus lack passes. In every case, these lagoons are shallow, being largely filled with muddy sediments. Evidently sediments accumulate slowly in open lagoons.

Characteristics of Raroia

Location 15° 55' S to 16° 14' S Lat., and 142° 18' W to 142° 32' W Long.	
Winter temperature of surface sea water	26° C
Prevailing winds	Easterly
Cyclones (hurricanes)	Westerly
Rainfall (1950)	110 cm
Tides	0.6 m
Area of atoll (including lagoon)	400 km^2
Area of lagoon	340 km^2
Area of atoll rim	60 km^2
Length of atoll	44 km
Breadth of atoll	14 km
Maximum depth of lagoon	55 m
Maximum height of land	6 m
Circumference at outer reef edge	90 km
Average breadth of atoll rim	0.6 km

1/ The outer gravel rampart at the elbow of Oneroa, the westernmost point of Raroia, reaches the extreme elevation of 19 to 20 feet above normal high water. A few other points on the atoll are 12 to 15 feet above normal high water.

Land area (35% of rim)	21 km^2
Vegetated area	6 km^2
Lagoon patch reefs (number)	ca 2000
Ship passes (number)	1
Visibility of 8" secchi disk	
Ocean	34 m
Lagoon	28 m

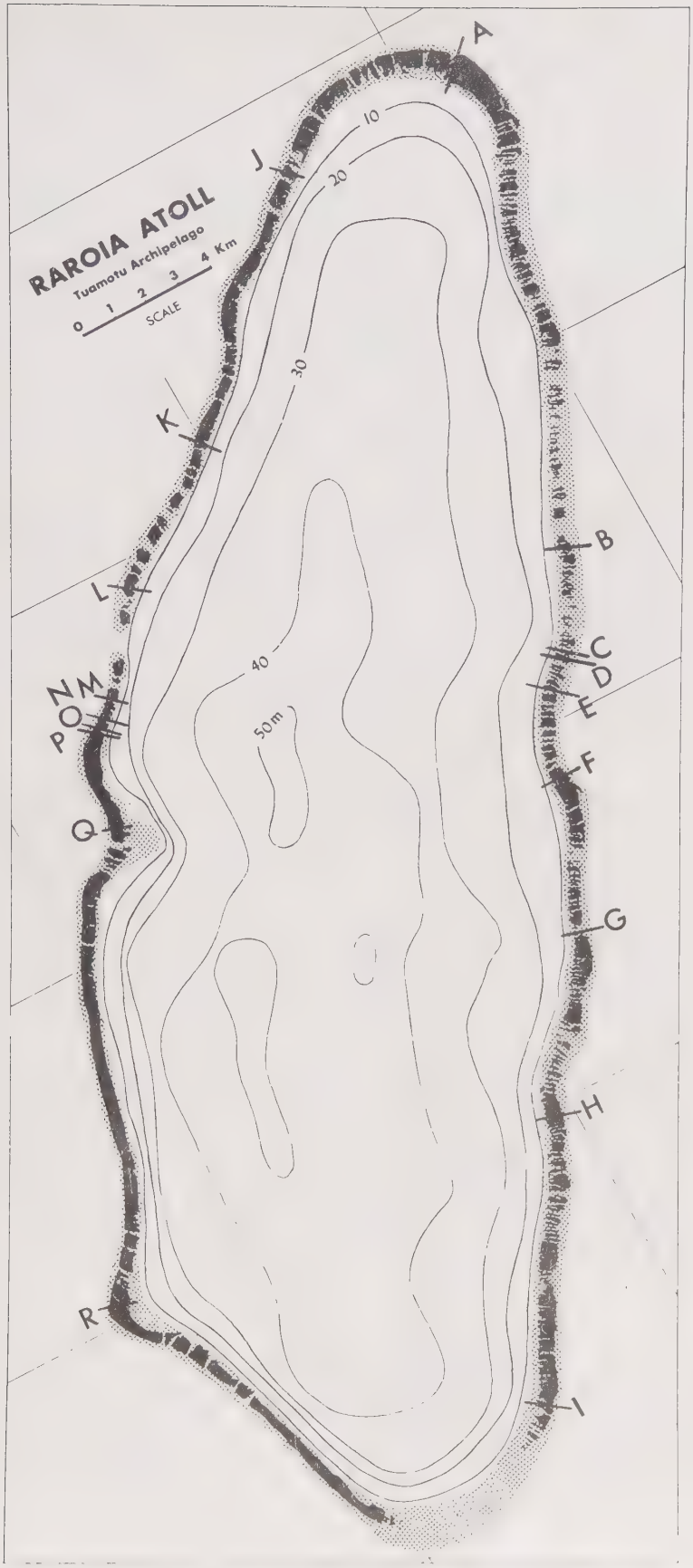
Distribution of underwater terraces, reef, and land forms recognizable on the photographs were mapped for the entire atoll and salient geologic features were recorded by means of aerial and ground photographs and by maps and cross-sections. A number of topographic profiles were constructed across the atoll rim, and in certain critical places levels were surveyed by means of alidade and plane table. Underwater observations and photographs were made with the aid of two Browne masks and a motor-compressor built at The American Museum of Natural History. A bathymetric map of the lagoon was prepared by Byrne from handline soundings. All of these observations reveal a number of facts of interest.

The Atoll Rim

Introduction.-The rim of Raroia atoll is narrowest, averaging 500 to 700 meters wide, along the northwest side where there are relatively few channels and the greatest extent of vegetated island upland. Much of the surface here rises from one and a half meters to three meters above normal high water level. On the other hand, the broadest sector of the rim, 800 to 1250 meters wide, is at the south end of the atoll (see general map, Section 3 of this Bulletin), where the surface is more or less continuously awash. This is the lowest part of the rim. In other sectors intermediate conditions between these extremes are found.

Although it cannot, of course, be supposed that the rates of reef growth are uniform all around the atoll, it is probable that wave truncation of the existing land areas and deposition of the resulting debris in the lagoon would result in a more nearly uniform rim width than is now the case. We may surmise with confidence that the relative narrowness and height of the northwestern rim are a result of full exposure to the most violent storms.

Channels and islets.-There is only one ship pass through the leeward rim and on the neighboring twin atoll, Takume, there is none. The Raroia pass is narrow (700 m) and shallow (five and one-half to eight meters) and choked by vigorous coral growth which may eventually block the pass. At the south end of the atoll facing the strong southern swell characteristic of the region, there is a broad inundated sector of the rim approximately five kilometers long and one and a half kilometers wide which is barely awash at low tide. Elsewhere, there are approximately 260 shallow channels across the rim which are drained or are awash during low water at the seaward ends and covered by two to two and a half meters of water near the lagoon ends. There are roughly 280 islets around the atoll, of which only 60, including most of the larger and higher land areas, are on the leeward (northwest) side of the atoll. Although the larger islets also lie on the leeward side of neighboring Takume, this is



5. Hydrographic map of Raroia atoll, and location of profiles.

unusual among atolls, even in the Tuamotus, because most frequently the land areas are concentrated to the windward where gravel and sand are most vigorously heaped up by waves. The storms of greatest violence regularly strike the west (lee) side of Raroia and Takume and there is much evidence of island building by hurricanes there.

In addition to the shallow channels or spillways between islets, there are some 160 deep, angular clefts or notches (incomplete channels) in the lagoon shore similar to the channels except that they do not extend across the island to the seaward side. These clearly are being lengthened headward as storm waters cross the islets toward the lagoon, and they represent various steps in formation of shallow channels. The method of formation of the channels is itself an interesting problem considered more fully on subsequent pages. It is concluded that the shallow channels are all of very recent origin and were formed chiefly by mechanical (hydraulic) erosion of the uplifted rim, but the ship pass probably has been inherited from a Pleistocene low water level.

Island conglomerate platform.-The smaller islets are formed of a flat platform of coarse limestone conglomerate (pakokota in Tuamotuan) from about one-half to a little less than one meter above normal high water on which, here and there, are small patches of sand and coral debris generally lagoonward of the islet center (Figs. 6, 7). A few of these patches of rubble are vegetated; the rock platform is bare. The larger islands are bordered by the rock platform, but wells dug in the interior (Garumaoa, Oneroa, Tetou) reveal that the central areas are underlain by uncemented sand and gravel to the water table, becoming loosely cemented below the water table.

Joints.-Irregular joints are visible here and there on the conglomerate pavement but they do not show lineation. Joints somewhat opened by solution are occasionally visible on bare areas of the outer reef flat near the shore. These are slightly sinuous and generally are approximately parallel with the reef front. None can be followed more than about 100 meters. Presumably they have been produced by adjustments or slump in the marginal talus of the atoll. There is not any visible displacement along these joints, but the effects of differential movement would probably be quickly effaced by erosion.

Ramparts and beaches.-One or more rampart ridges of gravel on the rock platform defend the seaward sides of nearly all the islands. These are coarsest and highest along exposed promontories. The highest surface on the atoll (approximately six meters) is the crest of a rampart on the leeward side of the atoll (at Oneroa, Fig. 7,B). In more sheltered places the ramparts tend to flatten, becoming sandy beaches. These are all storm features which lie inland upon the rock platform at some distance from the normal high water line. Eolian sediments are completely lacking on Raroia.

Island gravel.-A striking feature of the surface away from the lagoon shore on the lee side of the atoll is a veneer of coarse, algal-blackened coral rubble with very little sand. Reef blocks up to a meter or so in diameter, including corals which live only in fairly deep water outside the atoll (Acropora conigera), are scattered over the land on the leeward side of the atoll as far as the lagoon shore. These are storm gravels deposited by sheet flood

during hurricanes. The gravel is coarsest on the northwest rim of the atoll, appreciably finer on the southeast side, which generally is the sheltered side during hurricanes. This surface gravel does not contain fine sediment, but the interstices are sandfilled a few centimeters below the surface. Presumably, the water which passes over the islands during storms has capacity to carry sand and humus lagoonward, leaving well-washed coarser rubble on the higher ground near the outer shore and somewhat finer sediments near the lagoon. Some sand is trapped between pebbles, however, and doubtless it is washed downward by the rain. Pits dug on the larger islands show that the upper one to two meters of earth is composed of coarse rubble and entrapped sand which could have been deposited only by violent storms.

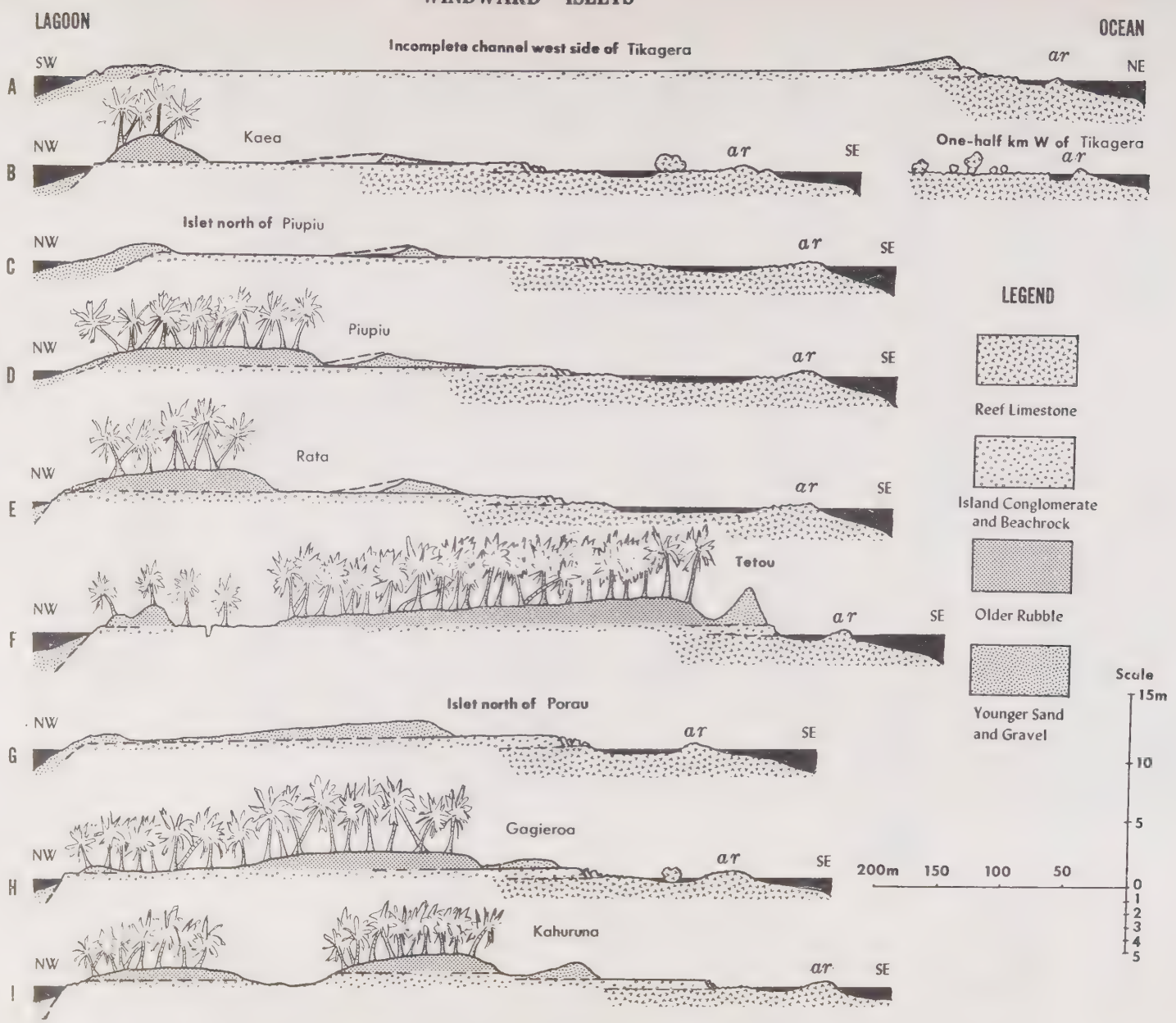
Submerged terraces.-There is evidence of an outer terrace believed to lie at approximately 20 meters similar to those described for Bikini (Tracey, Ladd, and Hoffmeister, 1948) and Andros Island (Newell, Rigby, Whiteman and Bradley, 1951) and there is a shallower terrace which slopes outward at the reef front from about low water level to eight meters. A submerged rock terrace, probably also at about eight meters, lies along the lagoon shore. This is largely covered, however, by sediments and fringing reefs so that the depth to the terrace rim cannot be determined accurately. Usually there is a pronounced break in slope at about five meters or so.

Erosion of the land.-The rocky outer shore all around the atoll is being cut away and the land area is decreasing. Outlying erosion remnants on the reef flat show clearly that the shore has retreated along a broadly curved front as much as 20 or 30 meters since the conglomerate platform was formed and elevated. Most of the products of this erosion together with the coral gravel and foraminiferal sand swept through the channels during storms accumulates in the lagoon, which in spite of heavy sedimentation is moderately deep (55 m) and is floored by fine sand and gravel rather than mud.

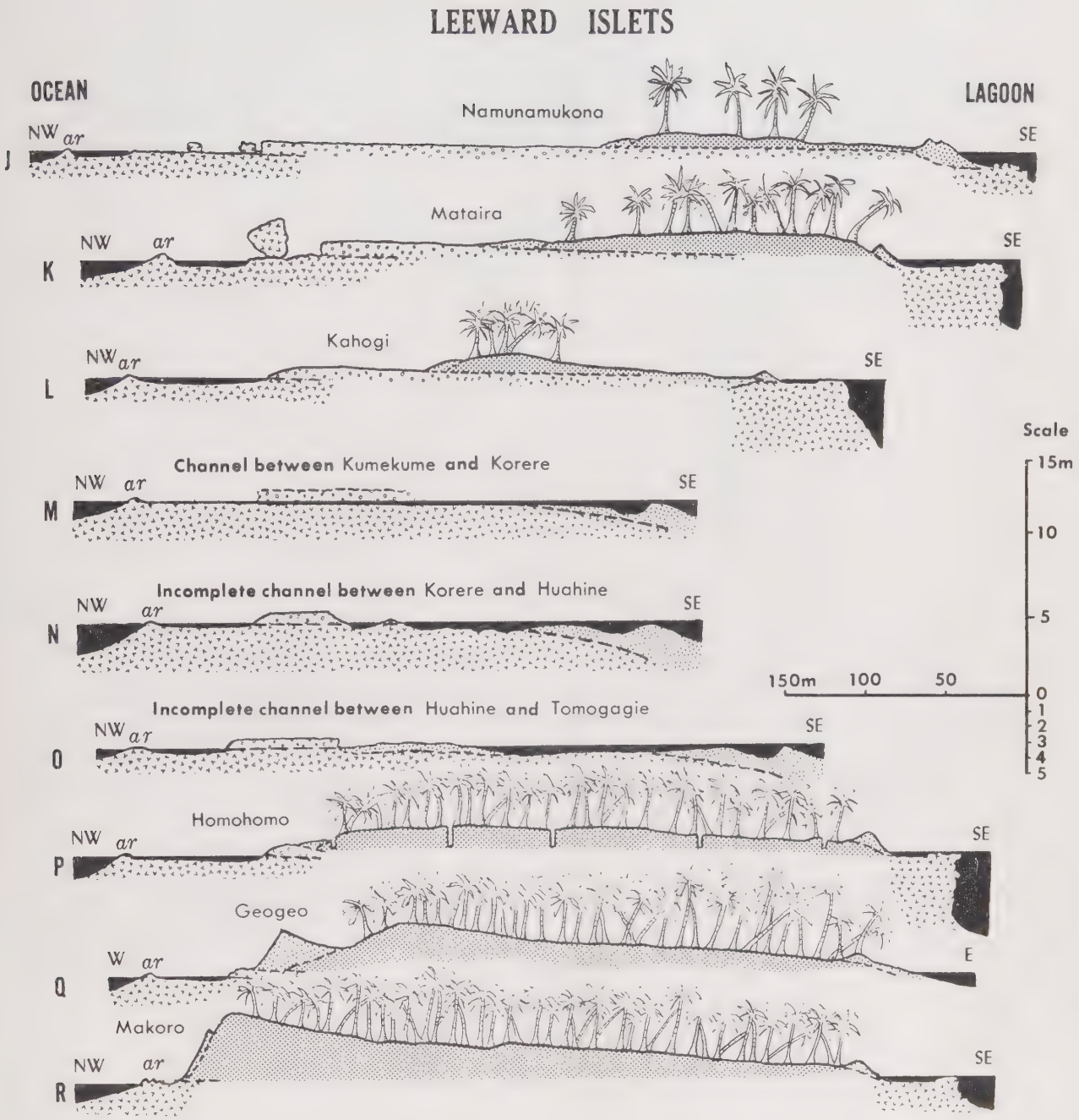
The water of the channels on the windward side and at the broad reef flat at the south end of the atoll generally flows lagoonward, even during low water, because of the strong swell. There is reversal of flow in the larger channels on the leeward side of the atoll where the wind generates a feeble seaward current during high water, but this current carries hardly any sediment.

Lagoon shore currents receive and rework the debris from the seaward reef which, together with lagoonal sediments, forms a nearly continuous band of beaches, beach ridges, spits and bars; these are mainly sand along the leeward (southeastern) shore and sand and gravel on the windward (northwestern) shore of the lagoon. Each channel is marked at the lagoon by a small crescentic delta of more or less loose sediments, and there is little or no reef growth at these places.

Accretion of sediments along the lagoon shore tends to mask signs of erosion and retreat of the shore, but almost all the islands have low headlands and outliers of beach rock rising a few centimeters above high water. The edge of the beachrock has been cut back at many places some 15 or 20 meters since it was formed. However, it appears that the lagoon shore may be advancing lagoonward at the northeast and southwest ends of the atoll.



6. Windward islets, profiles.



7. Leeward islets, profiles.

Ground water.-Analyses of nine well waters were made at the Garumaoa village near the close of a dry period (June 29) when the wells were being used to capacity. Therefore, the salinity was probably higher than the average for a year. Salinity was determined by hydrometer measurement. Values for pH were obtained with a Gamma electric meter loaned by the U. S. Geological Survey for the purpose. Total hardness was determined by titration. Because of inadvertent omission of an essential reagent, chlorinity of the water could not be determined. The wells ranged from about 14 to 17 parts per thousand salinity, with pH of 7.6 to 7.8. Total hardness ranged between 240± 13 to 360± 13 parts per million.

Garumaoa and other well waters

Well #	Temperature C°	Salinity o/oo	Hardness o/ooo	pH
1	26.5	14.4	320 ± 13	7.8
2	25.0	14.6	360 ± 13	7.6
3	25.0	13.9	280 ± 13	7.7
4	26.0	14.2	240 ± 13	7.7
5	26.0	14.2	300 ± 13	7.6
6	25.0	14.1	340 ± 13	7.8
7	27.0	14.2	360 ± 13	7.7
8	25.0	15.4	360 ± 13	7.7
9	26.0	16.6	360 ± 13	7.6
10*	--	4.1	-- -	-

*Well at Tetou, little used, August 23; the others are at Garumaoa, June 29.

Five test pits were dug to the water table in a series across the north end of Garumaoa Islet (Fig. 8). The pits at each end of the series were within 75 meters of the sea. Analyses of water samples from these pits are shown below. Pits four and five were not dug until after the onset of showers which came shortly after the middle of July, breaking a drought of many weeks.

Water analyses from test pits on Garumaoa

Pit #	Temperature C°	Salinity o/oo	Hardness o/ooo	pH
A (5)	26.0	4.1	380 ± 13	7.5
B (2)	26.0	9.0	420 ± 13	7.9
C (4)	25.0	3.5	420 ± 13	8.0
D (3)	27.5	7.6	420 ± 13	8.1
E (1)	24.2	3.7	420 ± 13	7.9
Pond #				
1	24.7	35.5	4000 ± 130	7.9
2	23.5	5.6	400 ± 13	8.3

All of the wells and moat ponds rise and fall with the tides, but the details of effects of tides on the lens of ground water were not studied. In general it appears that the fresh water lens is adequate for plants and animals on the larger islands even during periods of drought. Rain-water cisterns

supply nearly all of the drinking water, however, at the village. In all of the wells and pits the sand and gravel were unconsolidated down to the highest level of the fluctuating water table. Below this level the sediments are loosely cemented to form friable calcarenite.

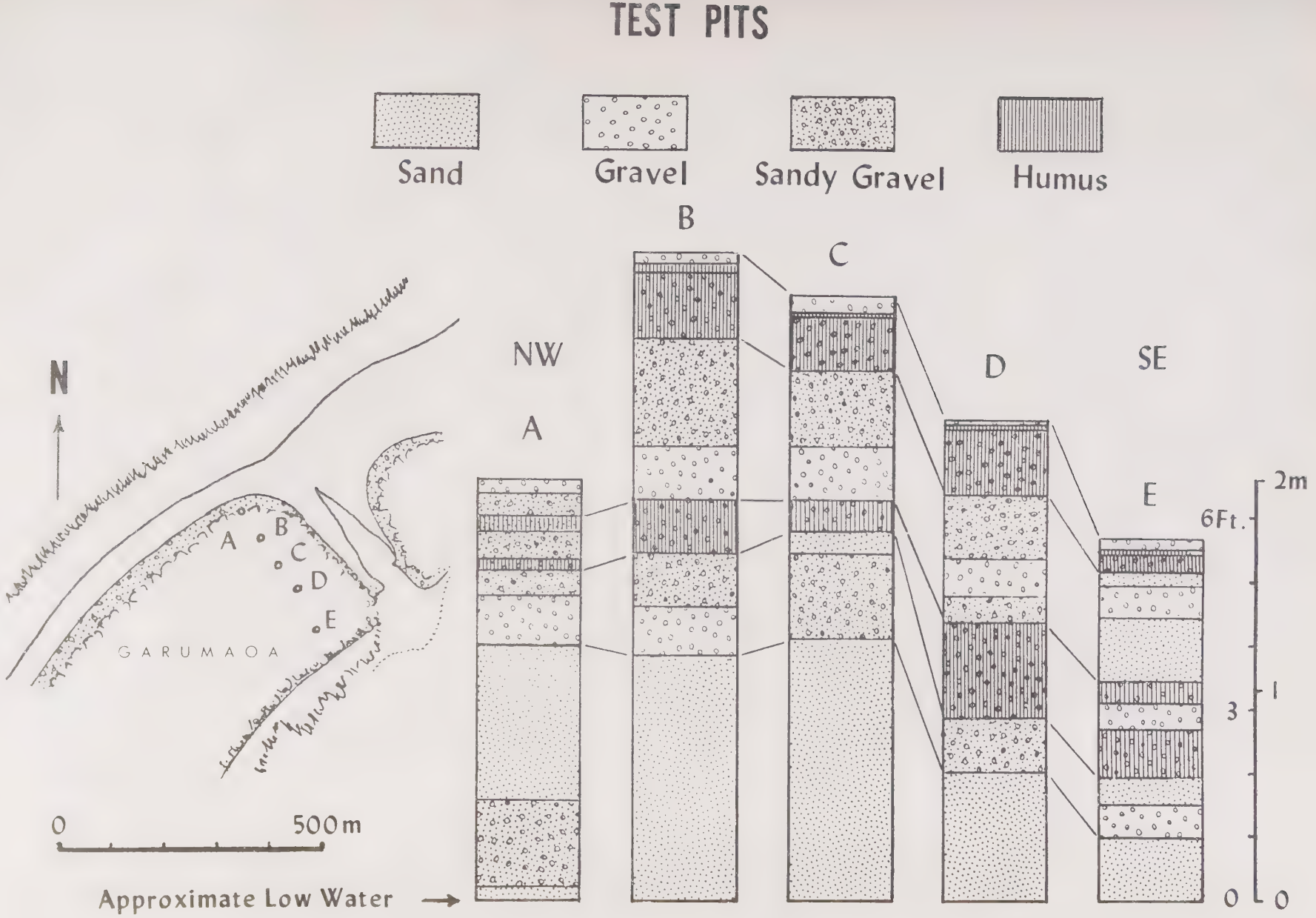
Soils.-The land areas of Raroia are almost destitute of soil over all but the lowest surfaces. Probably leaf mold and humus are periodically stripped away or buried by sheet flood during hurricanes. Sulphurous muck is found in a few swampy areas just inside the lagoon beach ridges. These are natural moats and the waters are quite saline (see preceding table, pond 1). Farther inland are small taro pits all dug before the present century. The muck of these pits is acid. As might be expected, the surface rubble of the islands generally is alkaline. The conglomerate, coral gravel and foraminiferal sand which compose the islands are nearly pure calcium carbonate. Clay minerals and silica occur only as traces and do not form significant accumulations. High alkalinity is assured by the local custom of periodically burning over underbrush and coconut husks, which results in the disintegration and calcining of the surface gravel.

Stratigraphy.-Five test pits two to three meters deep were dug across Homohomo (north end of Garumaoa Islet) in order to study the succession of deposits and to secure samples of ground water (Fig. 8). The outer pits were near the two shores and the oceanward hole was dug within 20 meters of the conglomerate platform. Contrary to expectation the conglomerate, composed of firmly cemented coarse debris of corals, was not encountered in any of the pits, although all were deep enough. Thus apparently it does not form the foundation of this large island as with the small islands. The succession of strata penetrated in these pits is remarkably uniform across the island. There is a lower unit of well sorted medium limesand which extends upward from the high water level some 50 to 240 centimeters. This is overlain by coarse, sandy gravel 150 to 350 centimeters thick containing one or two buried soil zones and a poorly developed humus zone at the top. Wells at Garumaoa, at Oneroa and Tetou also show that the sediments are generally finer below and coarser above. Samples of the sediments exposed on the five test pits were collected for soil analysis and carbon 14 determination. It seems probable that the onset of deposition of the coarse materials may have originated in a marked climatic change, such as development of, or shift in, a hurricane track. The slight drop in sea level discussed earlier probably resulted in increased rates of erosion of reef and island conglomerate.

Logs of five test pits at the north end of Garumaoa Islet (Fig. 8)

Test pit A (5). Northeast corner of Garumaoa Islet, Depth of hole, 79 inches.

Top		Inches
Bed 1.	Loose gravel	2
2.	Algal crust on pebbles	½
3.	Gray-buff sand and gravel	4
4.	Gray sand with some humus	3
5.	Gravel, subangular pebbles up to 4"	5



8. Correlation of strata in test pits, Garumaoa Islet.

Bed 6.	Sandy gravel with roots	2
7.	Sand, light-buff with scattered pebbles	5
8.	Coarse gravel, washed, angular, a few boulders	9
9.	Sand, medium, well sorted, light-buff	29
10.	Sand, gravelly, grayish	16
11.	Sandstone, like above	3+

Salinity 4.1; original temperature 27°C.

N.B. Roots occur scattered throughout, but predominate at levels indicated above. The section looks as though beds above #6 are result of burial of older profile, perhaps by 1903 hurricane.

Test pit B (2). North end Garumaoa Islet. Depth of hole, 121 inches.

Top		Inches
Bed 1.	Mantle of coarse angular coral fragments, the whole being coated black at surface by blue-green algae	2
2.	Dark-gray sandy gravel with organic material	2
3.	Gray sandy gravel with many roots	12
4.	Gray sandy gravel	20
5.	Open coarse gravel	10
6.	Small cobbles with open interstices several inches across; lowest root zone	10
7.	Poorly sorted sand and gravel	10
8.	Poorly sorted subangular gravel, no sand, unconsolidated	9
9.	Semi-consolidated, coarse sand, light-buff, rather well sorted (beach sand)	46
	Water table	

Salinity 9.0; original temperature 27.5 C; pH 7.92; hardness 420 ± 13 parts per million.

Test pit C (4). North end of Garumaoa Islet. Depth of hole, 113 inches

Top		Inches
Bed 1.	Unsorted coral gravel, washed	3½
2.	Algal film on pebbles, black	½
3.	Gravelly sand, dark-gray, with small roots	6
4.	Sand and gravel, darker, major root zone	4
5.	Sand and gravel, light-gray, buff, some cobbles	14
6.	Angular small cobbles and gravel, grading down into sand, light-gray	10
7.	Brownish dark-gray, sandy, with a few roots, humic soil with a few pebbles	6
8.	Brown, well sorted medium to fine sand	4
9.	Brown gravel, sandy, fragments up to 8 inches	16
10.	Sand, coarse, light-tan, well sorted with a few small pebbles; lightly cemented	49
	Water table	

Salinity 3.5 (diluted by recent rain); original temperature 28°C, pH 8.0.

Test pit D (3). North end of Garumaoa Islet. Depth of hole, 90 inches.

Top		Inches
Bed 1.	Surface veneer gravel	1
2.	Black humus and leaf mold	1
3.	Gravel, gray, sandy, with roots	12
4.	Gravel and cobbles, sandy, light-gray, with a few small roots	12
5.	Gravel, washed, subangular, up to 3 inches with open interstices, fine roots	7
6.	Sand and coarse gravel, light-buff, fine roots	5
7.	Brown sandy humic soil, gravelly, darker at top	18
8.	Gravelly sand, yellowish tan	10
9.	Sand, coarse, light-buff, well sorted with a few small pebbles	24
	Water table	

Fluctuation of water level at least 10 inches.

N.B. The sediments below #7 are tan, those above are light-buff to bone colored.

Test pit E (1). Northeast corner of Garumaoa Islet (see Figure for location). Depth of hole, 68 inches.

Profile

Top		Inches
Bed 1.	Surface coral rubble, partly calcined by burning; no sand visible; fragments small pebbles to boulders	2
2.	Upper half inch black, humic, lower part dark brownish-gray sandy gravel full of small roots, mainly horizontal (2 samples)	$4\frac{1}{2}$
3.	Sand with pebbles, light-gray (sample taken)	$2\frac{1}{2}$
4.	Pebbles and cobbles, subangular, light-gray, no sand	6
5.	Sandy gravel, light-gray	12
6.	Humic soil, dark-gray, sandy gravel, full of living roots, both horizontal or vertical (sample)	4
7.	Gravel, hardly any sand (sample)	5
8.	Sand, brown, pebbly (sample)	9
9.	Buff sand and pebbles (sample)	5
10.	Gravel, washed, no sand	6
11.	Sand, buff, with a few pebbles (sample)	12
	Water table	

Original temperature 27.5°C.

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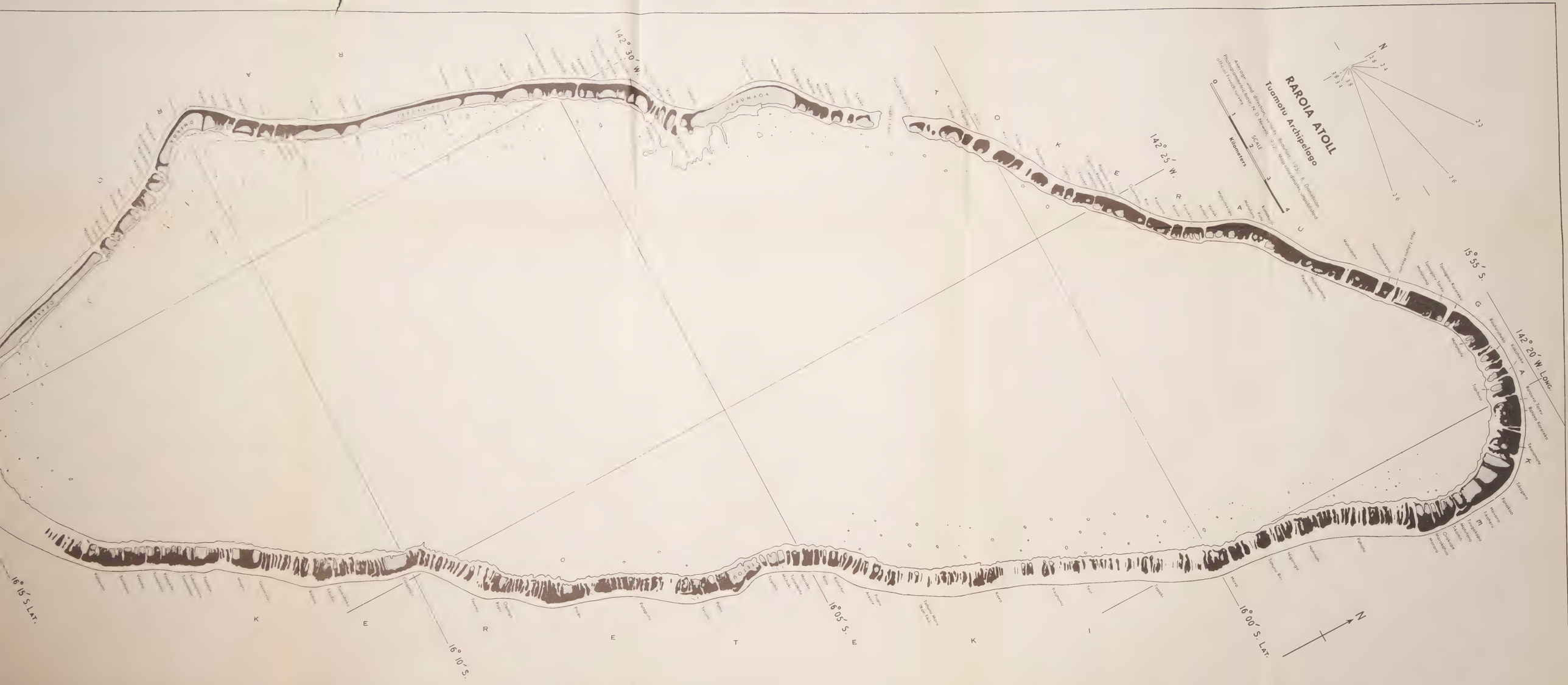
Part 3

GENERAL MAP OF RAROIA

by Norman D. Newell

Abundant patch reefs across the central part of the lagoon have not been mapped. Stippled areas, vegetation cover; black areas, bare land surface (limestone, gravel and sand). Original wind data corrected for magnetic declination.


RAROIA ATOLL
Tuamotu Archipelago
Kilometers
SCALE
142° 30′ W.
142° 25′ W.
142° 20′ W. LONG.
15° 55′ S.
16° 15′ S LAT.
16° 10′ S.
16° 05′ S.
16° 00′ S. LAT.
N
OCEAN
KEREMUTU
TOKERAU
KEREMUTU
TETEKI

ATOLL RESEARCH BULLETIN

No. 32

Raroian Culture

Part 1. Economy of Raroia Atoll, Tuamotu Archipelago

by Bengt Danielsson

Part 2. Native Topographical Terms in Raroia, Tuamotus

by Bengt Danielsson

Part 3. Native Terminology of the Coconut Palm in Raroia Atoll

by Bengt Danielsson

Part 4. Bird Names in Raroia Atoll

by Bengt Danielsson and Aurora Natua

Part 5. Check List of the Native Names of Fishes of Raroia Atoll

by Bengt Danielsson

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November 30, 1954

Part 1

ECONOMY OF RAROIA ATOLL, TUAMOTU ARCHIPELAGO

by Bengt Danielsson

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ECONOMY OF RAROIA ATOLL,
TUAMOTU ARCHIPELAGO

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To all these persons I say: Mauruuru!

INTRODUCTION

When and how the study was made

In accordance with the general aims of the Pacific Science Board's Coral Atoll Project, this study deals principally with ecological relationships considered from the point of view of the native population, or, in other words, it is a study of the economic life on Raroia atoll in the Tuamotu Group, French Oceania. As it examines the present-day economy seen in its wider context, it could also be called an acculturation and functional study, but the simpler and more commonly acceptable title "Economy of Raroia" has been preferred.

Most of the data on which the study is based were collected by 1950, i. e. two years before the Pacific Science Board's expedition visited Raroia.

Raroia was actually chosen primarily because of this previous knowledge of ours on conditions there.

Our own first visit to Raroia dates back to August, 1947, when we spent a fortnight there together with the other members of the Kon-Tiki expedition. This short stay was enough to make us interested in the acculturation processes in the Tuamotus and to convince us of the advantages of undertaking study of this aspect of the culture in Raroia, where (a) the population was small enough to be studied in its entirety and not just by means of sampling and (b) we could be sure of whole-hearted cooperation with the islanders. Our project was eventually realized when we returned to Raroia in November, 1949. The total time spent on the atoll this time was 18 months (until April, 1951), and the period covered by our study included the whole year of 1950.*

From our rather comprehensive data on acculturation collected during this period, we selected during our third stay in Raroia, June 19 to September 7, 1952, as anthropologist of the Pacific Science Board's team, those data dealing with economic and related activities. The data were carefully checked whenever possible and a certain amount of additional information was obtained. Some rough outlines were prepared even while we were still in the field, but practical duties and the collaboration with other team members on various studies (which will be presented separately), made it impossible to write up our material on the spot, although we had planned to do so in order to achieve maximum accuracy.

The final shape of the study is determined principally by our endeavour to conform as much as possible to the general plan for the Coral Atoll Project, decided upon at the outset. In Spoehr's words (Atoll Research Bulletin No. 17, Handbook for Atoll Research, page 109) the guiding principles are, that observations during field expeditions should:

"(a) Focus on the present rather than the aboriginal past...

(b) ...elucidate processes involved rather than static patterns...

(c) Operate with a set of problems suitable for comparative investigations..."

These principles already guided our work before our participation in the Coral Atoll Project, and were still more rigidly adhered to during the preparation of the present study.

The data which were judged essential to gather for a study of this type were grouped by Mason (Atoll Research Bulletin No. 17, Handbook for Atoll Research, page 111) under the following headings:

1. population inventory
2. economic activities
3. land tenure
4. social and political organization
5. movement of peoples

*For a popular account of our experiences during this stay, see: Danielsson, 1953.

We have followed this general outline - as Mason did himself at Arno and Goodenough did at Onotoa - in order to achieve the goal which we believe is of utmost importance, viz. to provide a common basis for comparisons of atoll cultures. It is also our conviction, that only through this standardization of methods will it be possible, ultimately, to transcend the short-time practical value of the studies and make contributions to the more important theoretical task of discerning and formulating basic social laws.

It must be noted here in passing, that the present study, although planned with these objectives in mind, nevertheless covers two of the three fields of special interest to the South Pacific Commission, viz. Economic and Social Development, and partly follows the program for coral research of immediate practical value, as outlined in Project No. E.6 of the Commission.

Thus, while our selection of data has been determined by the considerations detailed above, the presentation has been guided by their place in the functional context. Both the population inventory and the data on inter- and intra-island movements are for instance grouped together in the same chapter, called Demography. Two specific chapters are devoted to surplus production and subsistence activities, whereas discussions of social implications of the economic organization are interspersed throughout the text. Land tenure is linked with inheritance practices and legal problems, and so on. Wherever necessary for the elucidation of the situation, historical material has been included.

The curious situation in Raroia, where the economy is neither primitive nor modern but somewhere in between, has made it impossible to use the conventional classification of the material under the heads of Production, Distribution, Exchange and Consumption, and in this case also the functional context has, therefore, determined the presentation of the material.

Finally it must be understood that the present study is not in any way definitive, but should rather be regarded simply as a collection of raw data together with some tentative interpretations. We hope eventually to be able to enlarge and improve on the study in the following ways during a future visit to Raroia:

(1) by gathering additional material on the economy (especially the nutrition);

(2) by including material dealing with other aspects of the culture, such as health, religion, political organization, recreational activities and others;

(3) by further analyzing the interactions and interrelationships.

In addition it would certainly be worth-while comparing the situation in Raroia with that in other parts of Polynesia as recorded in the literature, in order to gain a wider perspective and better understanding of universal acculturation processes. Or in Keesing's words: "Polynesia thus forms an ideal laboratory of acculturation processes, with the open spaces of the Pacific giving perhaps the nearest equivalent available in human studies to test tube isolation and control." (Keesing, 1947 p. 39).

Chapter I

HABITAT AND HISTORY

Physical features

The Tuamotu Group, which is a part of French Oceania (Etablissements Francais de l'Oceanie), lies immediately East of Tahiti. It is made up of 78 atolls scattered over the huge area between 135 to 149 degrees West and 14 to 23 degrees South. The distance from Tahiti to the nearest atoll is 130 nautical miles and to the most distant easternmost about 800 nautical miles.

With the exception of the raised phosphate island of Makatea all the atolls are low with a maximum elevation rarely exceeding 20 feet. Three of the atolls are more than 60 km (kilometers) in length, about 30 are less than 10 km in diameter, and the rest are of all sizes in between. Most of the atolls in the Western part of the group have passes deep enough for trading schooners; most of the atolls in the Eastern half of the group lack passes.

The following more detailed description of Raroia is taken from the preliminary report of the geologist of the Pacific Science Board team, Dr. Norman D. Newell:

"The rim of Raroia is extraordinarily narrow and contains much land surface. There are many shallow channels that have cut since the land was formed, but there is only one ship pass....The lagoon is moderately deep and occupied by a large number of patch reefs (between 1,600 and 2,000) arranged in quadrangular patterns."

The general characteristics of the atoll are, according to Dr. Newell, as follows:

Length	44 km
Breadth	14.4 km
Circumference at edge of outer reef	90 km
Area	ca 400 km^2
Lagoon area	ca 340 km^2
Lagoon maximum depth	55 m
Atoll rim area	60 km^2
Land area	21 km^2
Average breadth of rim	0.6 km
Maximum height of land	6 m

Dr. Maxwell Doty has calculated the vegetated area with the help of the aerial photographs and found it to be 921 hectares. Of these, 587 seem to be

planted with coconut palms, while the remaining 334 hectares are covered with other vegetation, mostly Guettarda speciosa, Messerschmidia argentea, Pemphis acidula and Pandanus.

Climate

The climate in the Tuamotu Group is hot and dry, but refreshing easterly trade winds blow all round the year. The temperature varies very little between night and day, and the water is only slightly cooler than the air. There are two clearly distinguishable seasons, one relatively rainy period lasting from November to April and one relatively dry period from May to October. During the rainy season devastating hurricanes occur at long intervals, the last ones sweeping through the group in 1903 and 1906.

It must be recalled here, that these hurricanes accelerated the acculturation process in many atolls, as the taro pits were filled with gravel. Houses, tools and canoes were completely destroyed. When the islanders had to recover and rebuilt after the hurricanes they replaced in most cases the native foods and objects with imported European articles. The cyclones constitute therefore a break in the economy and material culture (and in many atolls in spiritual culture too, through the loss of the old family books containing the historical traditions).

We recorded meteorological data in Raroia for the whole year of 1950. These are published elsewhere (See Danielsson, 1951), therefore only the main characteristics of the climate are given here:

Maximum temperature, annual average	30.4°C(86.7°F)
Minimum temperature, annual average	23.3°C(73.9°F)
Total annual rainfall	1181 mm (46.5 in.)
Total number of days with rain	132
Number of windless days	37

Natural resources and acculturation

Few plants and land animals exist in the group (For detailed information see the publications on botany and zoology by other team members in following numbers of the Atoll Res. Bull.) and only about twenty species of sea birds are found, but the sea teems with fish (See Atoll Res. Bull. No. 18) and the lagoons contain an abundance of clams and crustacea in most atolls. The environment and natural resources are therefore very similar to those found everywhere on atolls in the South Pacific.

Keesing has classified the Polynesian islands in the following way (Keesing, 1953):

Type I: Small islets without adequate resources.

Type II: Small islands, usually atolls, with limited resources and poor sea approaches.

Type III: Small islands with special commercial resources.

Type IV: Larger islands, usually volcanic, which are isolated and have poor sea approaches.

Type V: Larger islands, usually volcanic, which are conveniently situated and have good harbors.

There is a definite correlation between the type of island and the acculturation process, a fact which has been brought out repeatedly by previous studies in Polynesia. That the cultural situation in Raroia is typical for islands of type II will be shown by the present paper.

Pre-European culture

The Tuamotu atolls were settled from Tahiti, the Marquesas and perhaps also from other surrounding islands at varying periods. The Raroian traditions claim that the atoll has been permanently inhabited since 30 generations ago (about 1450 AD). The Tuamotuan culture therefore naturally resembled that of the neighbour groups, but had also several unique features. Many local variations existed within the group and some cultural sub-areas like Napuka, Reao-Pukarua, Fagatau* and Anaa could be distinguished. (See Report, 1932).

The social system was fairly democratic, and there were no classes. Generally each atoll was divided up into a number of districts inhabited by extended families. A paramount chief was sometimes recognized on an atoll, but his power was rather nominal, and the greatest social unit was in reality the family.

Hostilities were common between the atolls and sometimes even between the districts. The most feared warriors were those from Anaa, who at several instances ravaged even distant atolls in the group and killed or carried away their inhabitants.

The economy was a simple food-gathering and planting economy. The staple food plants were the pandanus, the coconut palm and the coarse taro. The pandanus and coconut palms did not require much care, but huge ditches had to be dug for the taro and considerable time was spent on the cultivation of it. Of animal food, fish occupied a very important place on the menu, and clams and crustacea were also regularly collected. Sea birds, eggs and turtles were seasonal sources of food. Of the commonly domesticated Polynesian animals, the pig and fowl were absent, but dogs were frequently kept and eaten.

The material culture was poor, and the only material for tools accessible in the atolls was bone and mother-of-pearl shell. Basalt adzes were therefore often imported from Tahiti. The houses were made of palm or pandanus leaves and rather crude, however good craftmanship was shown in the construction of sea-going ships. These were twin-hulled canoes with platforms and pandanus sails, capable of transporting several dozens of persons. There are known instances of travels exceeding 1,000 nautical miles in length.

*In accordance with the generally adopted convention "g" is used to indicate the English "ng" sound as in "sing." The vowels are pronounced as in Spanish.

Early discoverers

Quiros discovered seven atolls in the group as early as 1606, but with the exception of Anaa it is extremely difficult to identify them due to the vague positions given in the account of the voyage. The Dutchmen LeMaire and Shouten in 1616 and Roggeveen in 1722 were the next Europeans who passed through the group, and they discovered about a dozen more atolls. During the following hundred years Byron, Wallis, Carteret, Bougainville, Cook, Boenechea, Varela, Edwards, Bligh, Wilson, Turnbull, Kotzebue, Bellingshausen and Beechey gradually found the remaining atolls (See Buck, 1945). The last atoll was discovered as late as 1835.

Raroia was sighted for the first time on July 12, 1820 by the Russian explorer Bellingshausen, who proceeded along the Eastern shore. His observations are summarized in the following brief passage in the narrative of the voyage (Bellingshausen, 1945, Vol. I: 236):

"It (the Eastern shore) is covered with scattered undergrowth and low trees. Surf was breaking heavily on this coral shore. The northern and western sides from which the lagoon was visible were quite covered with trees, and at various points on the north-western shore we could see smoke rising up out of the trees, which showed that the island was inhabited. Mr. Lazarev informed me that he could see people and canoes on the shore."

Bellingshausen called the atoll, Barclay de Tollay, but this name, like all other European names bestowed on the Tuamotuan atolls, is absolete today and not even known by the natives.

History of later culture contacts

All these early explorers passed through the group quickly, and their contact with the natives was limited to the exchange of some small trinkets for coconuts and scurvy grass on the rare occasions when a ship hove to for a couple of hours at an atoll. From 1830 on, however, a new type of ship began to appear in the group, the trading vessel in search of pearls, mother-of-pearl shell and sea slugs. Native divers were engaged and islanders were taught to prepare the sea slugs.

As a result of these contacts new diseases spread and severe epidemics soon ravaged the group. As the natives had no resistance through previous immunity and lacked all notions of modern hygiene, even such comparably harmless diseases as measles and influenza were fatal. Many died and the population decrease was further accelerated through syphilitic sterility. The natives' mode of life was, however, very little affected by these infrequent visits of trading vessels, and during the period up to the 1860's, for instance, an atoll like Raroia was visited maybe only once a year or every second year.

During the second half of the century two new groups of Europeans gradually brought about profound changes. These were the missionaries and the copra traders. The first converts in the group were made already in 1817 in Anaa by protestant native missionaries instructed in Tahiti, but the new religion did not at this time spread widely and the number of protestant converts remained small.

An American missionary from the Church of Jesus Christ of the Latter Day Saints arrived in 1845 in Anaa and immediately won a foothold. Catholic missionaries prospected the Tuamotus for the first time in 1849, and installed themselves also at Anaa two years later.

Some of the inhabitants of Raroia were converted by other natives from Anaa at least as early as 1846, but the majority of the islanders still clung to their old faith when the first European missionary, a Catholic priest, arrived in 1869. Between this date and 1875 he succeeded during his repeated visits in converting practically the whole population, and a solid stone church, which is still standing today, was constructed.

The Protestant Church and the Latter Day Saints also made progress in the group during the same period, and with the increasing number of trading vessels that appeared, with the rise of the copra trade (for more details, see Chapter V), gradually all the natives became converted. The last islanders in the Tuamotus abandoned their old faith in 1888.

Politically the status of the group continued to be very vague even after the establishment of the French protectorate in Tahiti in 1843. Many of the western atolls in the group were regarded as a part of the Tahitian kingdom, and the Queen, Pomare, appointed in several cases both regents and judges, but no real authority was exercised. Most of the eastern atolls, among them Raroia, did not recognize even the formal sovereignty of Queen Pomare.

When Tahiti and other islands were annexed by France in 1880, the Tuamotu group was also incorporated as a new administrative unit, and from then on the atolls have been governed by French administrators aided by local chiefs, first appointed but since the end of the last war elected locally by popular vote. All the natives have been French citizens since 1945.

The situation today

The Tuamotus are today the part of French Oceania which is least affected by European culture, and practically no foreigners, White or Chinese, have settled in the group. This does not, however, mean that much of the old culture is left. On the contrary, the changes have been profound, and lovers of South Sea movies would not feel at home in Raroia. The material culture is almost wholly Western, and the natives use European tools exclusively, dress in European way and frequently have even such luxuries as radios, bikes and refrigerators. Many houses are, however, still made of plaited palm leaves, and the canoes are in general of Polynesian model with outriggers.

Of course not a trace of the old religion is left. The social structure has also changed considerably with the concentration of the people in central villages and the emergence of a new class of leaders, the native traders and catechists or ministers. Economically a whole revolution has occurred with the rise of the copra trade, and today almost everywhere in the Tuamotus the natives have abandoned the old subsistence economy in favor of a surplus production.

Even the language has undergone profound changes, and the Tuamotuan dialect is spoken today only by the old men and women in Raroia. As a result of the frequent contacts with Tahiti, the local dialect will probably in the end be completely replaced by Tahitian.

The main difference between the Tuamotus and Tahiti, (like most other large islands of type V, according to Keesing's classification) is that the Tuamotuan natives have preserved their economic independence and spiritual wholeness to a much greater degree than those in the islands of the latter type. In Raroia, as practically everywhere in the group, all the inhabitants still have enough land to secure a good living and many have a considerable income by any standard. With the words "spiritual wholeness" we simply mean that the atoll communities still are fairly homogeneous with few social, economic, religious or other stratifications. This difference between the acculturation situation in the two types of islands is more important than the similarities, and it is the main justification for affirming that the Tuamotus are the islands in French Oceania still least affected by Western culture.

The cultural situation, like the environment, is in its main characteristics similar throughout the group. There is a slight difference of degree, and as a general rule it can be said the impact of Western culture diminishes as the distance from Papeete increases. Raroia, situated at 142° West and 16° South, occupies therefore not only geographically but also culturally an intermediate position in the group.

Summary of culture contacts

In order to get a more quantitative measure of the acculturation process we shall try, finally, to summarize the type and frequency of the culture contacts. This summary, which of course is only a very rough and tentative evaluation, is presented in the following table:

Table I: Culture contacts

A. In Raroia:

Type of contact	Duration	Frequency	Period
Visits of trading schooners	1 - 2 days	Once a year	1830 - 60
Visits of trading schooners	1 - 2 days	5 - 6 times a year	1860 - 1920
Visits of trading schooners	1 - 2 days	Once a month	1920 -
Visits of missionaries	About a month	Once a year	1870 -
Visits of administrators	1 - 2 days	Twice a year	1900 -

B. Elsewhere:

Type of contact	Duration	Frequency	Period
Average visits by a Raroian to Tahiti	1 - 2 months	Every second or third year	1920 -
Average visits by a Raroian to other atolls during the diving season	1 - 4 months	Every second or third year	1900 -

Chapter II

DEMOGRAPHY

A. The Place of Raroia in the Tuamotus and French Oceania.

Before proceeding to the presentation and analysis of the detailed population data collected by us in Raroia, the place of the atoll in its larger demographic context has to be determined.

From the geographical, botanical and geological point of view Raroia is certainly typical for the Tuamotu group and does not in any marked respect deviate from the general pattern found, with surprisingly few variations, everywhere in the archipelago. Culturally Raroia occupies a central position between the more "conservative" Eastern atolls and the more "progressive" Western atolls, and is thus truly an "average" Tuamotuan atoll. But is the composition of the population also representative for the Tuamotus in general, and how does the Tuamotu group in its turn compare to French Oceania as a whole?

In order to answer these questions, we have compiled some comparative tables based on the latest census report (Teissier, 1953), to some extent supplemented with our own data. All figures in this section refer therefore to the situation at the time of the census, September 17-18, 1951. Our study is otherwise limited to the period January 1st to December 31st, 1950, but as no significant changes took place during the time up to the census, all findings in this section are valid also for the study as a whole.

The figures are broken down according to the following criteria: administrative unit, race, sex, age, marital status, professional situation, and church membership. No further analysis is possible on the basis of the available census data, and are, anyway, unnecessary for our limited purpose.

1. Administrative units.

On September 17-18, 1951, the total population in French Oceania was 62,828, divided among the five administrative units or groups in the following way:

Tahiti and dependencies	35,423
Leeward Islands	12,920
Tuamotu group	6,733
Austral Islands	3,983
Marquesas Islands	3,257
Mangareva	512

Of the 78 atolls in the Tuamotu group, many are grouped together for administrative purposes, which for instance is the case with Raroia and its neighbour atoll, Takume. The total number of these smaller units, usually called "districts" is 35, and the frequency distribution of the population is as follows:

Population	Below 100	101-200	201-300	301-400	401-500	Above 500
No. of distr.	4	19	8	1	1	2

The average population per district is 192, which is very close to the figure for Raroia-Takume, 160, but still more significant is of course the frequency distribution above, in which Raroia-Takume is in the modal class. As it is impossible with available data to compute the average population for each inhabited atoll, we have to content ourselves with these rather crude figures, which, however, clearly show that Raroia-Takume in this respect is typical for the Tuamotus as a whole.

Comparisons between the Tuamotus on the one hand and the whole of French Oceania on the other, are of course meaningless, as the other groups are completely different as to topography and general conditions.

2. Racial composition.

Race	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	Per cent	Total	Per cent
Pure Polynesian	40,099	64.3	5,905	87.8	97	87.3
Mixed Polynesian	13,769	21.9	742	11.0	12	11.0
Chinese	6,655	10.6	68	1.0	2	1.7
Caucasian	1,860	2.9	18	0.2	0	0.0
Other	445	0.3	0	0.0	0	0.0
Total	62,828	100.0	6,733	100.0	109	100.0

The attribution of a person to the class of pure or mixed Polynesians is in the official census made simply on the basis of his own declaration, and therefore can not be regarded as reliable. As a rule, however, the intermixture is undoubtedly less in the Tuamotus than in any other group in French Oceania, and the figures therefore certainly have some basis in fact. The percentages are anyway strikingly similar for Raroia and the Tuamotu group.

3. Sex ratio.

Sex	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	Per cent	Total	Per cent
Male	32,920	52.3	3,677	54.6	51	47.5
Female	29,908	47.7	3,056	45.4	58	52.5
Total	62,828	100.0	6,733	100.0	109	100.0

The disproportion between the male and female figures is very marked, especially if they are compared with Europe and America, where in almost all countries the difference is insignificant. The most surprising thing is that there is a surplus of males in all the five groups in French Oceania in spite of the varying local conditions. This situation seems also to be fairly stable, or at least has been for the last 50 years for which we have reliable data (Valenziani, 1949, p. 666).

Whatever the explanation may be for this curious preponderance of males, the Tuamotus follow the general pattern. That the figures are slightly more disproportionate in this group than in French Oceania as a whole is certainly due to a greater female migration to Tahiti. The figures for Raroia are strangely enough reversed, and seem to have been so for a long period. The percentages correspond to a sex ratio of 120 males to 100 females for the whole group, and 88 males for 100 females for Raroia.

4. Age classes.

Age	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	Per cent	Total	Per cent
Below 20	33,239	52.9	3,249	49.4	49	46.6
Above 20	29,422	46.9	3,317	50.6	60	53.4
Total	62,661	100.00	6,566	100.0	109	100.0

The official census separates the population only into two groups, those above and those below 20 years of age. For Raroia a more complete break-down and also separation according to sex has been undertaken in the section on Population trends (Part B. 2 of this Chapter), but here we follow simply the census.

The reversed figures for the Tuamotus when compared with French Oceania as a whole are certainly - like the similar disproportion between the sexes in the previous table - due to a migration to Tahiti. It seems to be a little more pronounced in Raroia than on the average, but on the whole it can certainly be said that generally speaking Raroia also in this case is typical for the group.

5. Marital status.

Status	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	Per cent	Total	Per cent
Unmarried	48,491	77.5	4,772	72.7	76	68.4
Married	14,170	22.5	1,794	27.3	33	31.6
Total	62,661	100.0	6,566	100.0	109	100.0

These figures should be compared with those in the preceeding table showing the age classes, where we find that roughly half of the population is above 20 and consequently of marriage age. (The figure is actually somewhat higher as the natives often are physically mature long before the age of 20.) The discrepancy between the number of marriageable and married persons is easily explained by the fact that the majority of the natives still have a considerable reluctance to adopt foreign patterns of a complicated legal character. Co-habitation without legal marriage is therefore the rule, and these de facto marriages are not shown in the census. The situation is evidently the same in Raroia as in the Tuamotus and French Oceania as a whole.

6. Professional status.

Status	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	per cent	Total	per cent
Employer	748	1.1	10	0.1	0	0.0
Employee	3,529	5.6	21	0.2	0	0.0
Independent	58,384	93.3	6,535	99.7	109	100.0
Total	62,661	100.0	6,566	100.0	109	100.0

The few employers, usually French or Chinese, and employees in the total population almost all live in Tahiti, the only island with an embryo of industry. In Raroia as well as everywhere else in the Tuamotu group the natives are practically all independent land owners who prepare the copra themselves, or with the help of friends who work part-time.

7. Church membership.

Denomination	French Oceania		Tuamotu		Raroia	
	Total	Per cent	Total	per cent	Total	per cent
Protestant	34,441	54.8	494	7.6	3	2.8
Catholic	15,096	24.0	3,443	52.4	100	91.7
Kanito*	2,073	3.1	1,346	20.5	4	3.7
Mormon**	1,218	1.9	510	7.7	1	0.9
Other	9,832	15.5	773	11.8	1	0.9
Total	62,661	100.0	6,566	100.0	109	100.0

* The Reorganized Church of LDS (Independence Branch)

** The Church of LDS (Salt Lake City Branch)

The clearly distinguishable geographical patterns are easily explained if we consider the historical sequences. The first missionaries in French Oceania were protestants. They established themselves principally in Tahiti, Moorea and the Austral and Leeward islands, where they soon converted the totality of the natives. Later arriving missionaries representing other churches (Catholic, Mormon and Kanito) concentrated therefore naturally on virgin fields like the Tuamotus and the Marquesas. There they succeeded in establishing themselves firmly before the protestants took up the competition in earnest. It is thus not surprising at all that the religious situation is different in the Tuamotus from that in the rest of French Oceania.

Whether Raroia is typical for the Tuamotu group or not, is another question which it is unfair to answer on basis of the averages alone, as the churches are not evenly distributed throughout the group. A more important criterion than the simple average number of persons belonging to the various churches, is therefore the number of churches represented on each atoll. In the following table the administrative units or districts into which the group is divided have been classified according to this criterion. "Major" is arbitrarily defined to mean a church of which above 50% of the population is member. If two churches exceed 35%, both are regarded as major, churches with less than 10% members have not been included.

Total no. of districts*	Number of atolls with -						
	1 major church	1 major + no. of smaller			2 major	2 major + no. of smaller	
		1	2	3		1	2
35	17	3	3	2	6	3	1

Out of the total number of 25 single major churches, 18 are Catholic, and out of the total number of 10 major churches sharing the dominance, 7 are Catholic. As Raroia-Takume not only belongs to the first class (atolls with only one major church), but also is Catholic, the district can be said to be much more representative than the mere averages in the census indicate.

8. Summary.

The question of the relationship between the Tuamotu group and French Oceania as a whole is already sufficiently illuminated by the data presented above, and we shall therefore limit ourselves here to a brief summary of the place of Raroia in the Tuamotu group. The size of the population of Raroia is close to the average. As to the racial composition, the age classes, the marital and professional status, the population in Raroia is identical or only insignificantly different from that of the whole group. The sex ratio shows a slight surplus of females, whereas generally in the Tuamotus there is a small surplus of men. In the religious field, finally there is a greater homogeneity than on most other atolls, as more than 90% of the population belong to the same church. These two last mentioned facts may have some influence on the social structure and economic pattern, the possibility of which will be discussed in later chapters.

*Atolls or group of atolls.

This influence must, however, at any rate be exceedingly small, and without hesitation it can be said definitely that Raroia in practically all respects is typical for the demographic set-up in the Tuamotuan atolls. As other factors like physical environment, general culture and economy are also shared with the whole group, the findings of the present study can certainly to a large extent be applied to the group as a whole.

B. Population Trends.

In the previous section a comparison of the composition of the populations in French Oceania, the Tuamotus and Raroia at a fixed time (census of 17-18 September, 1951) was made. The comparison was based on some basic characteristics selected by the census officials. Here additional data collected by ourselves in Raroia will be presented, and where possible the changes over longer or shorter periods will be followed, thus showing also the dynamic aspect of the population.

The material is arranged in three groups. The first deals simply with the general population trend in Raroia compared with that in the Tuamotus and other groups in French Oceania since 1863. The second contains data from Raroia on the natural increase during the period 1930-50. In the third group we find detailed information about the composition, migration and mobility of the population in Raroia, during the time of our repeated visits 1950-52. This gradual increase in the wealth of the documentation proportional to the nearness in time is only natural, as during our stays in the atoll we were able to gather much more and detailed information than usually can be included in the official records.

1. The native come-back.

At the end of the last century the Polynesian race seemed doomed. Since the first contact with Western culture the decline had everywhere been rapid, and it was widely thought that the Polynesians ultimately were to become extinct. A marked change has, however, taken place since then - maybe principally due to intermarriage and to a greater immunity against epidemic diseases - and in French Oceania as everywhere elese in Polynesia, the survival of the native population seems now assured.

In order to show this evolutionary trend and the possible local variations in the principal groups of French Oceania, we have prepared Table II, which excludes all other racial groups than the Polynesians, pure and mixed. The reason for lumping the pure and mixed groups together is simply that the exact degree of intermixture is impossible to determine in most groups (see Section A, 2). In Raroia where the islanders, as in many other of the Tuamotu atolls, still preserve their genealogies, an attempt has been made in Part 5 of this section to classify the inhabitants more accurately, but here the census figures, grouping mixed and pure natives together, will be used in order to permit comparisons.

Table II: Population trends in French Oceania, 1863-1951.

Group	YEAR								
	1863	1881	1892	1902	1911	1926	1936	1946	1951
E. F. O.	--	--	--	27,167	28,875	30,043	38,132	48,370	53,868
Tuamotu	6,588	5,500	4,734	4,294	4,711	4,276	4,668	6,142	6,647
Tahiti	7,642	8,500	9,500	9,634	9,128	8,335	13,182	17,456	23,812
Marquesas	12,000	5,776	4,445	3,563	3,116	2,255	2,400	2,968	3,257
Austral	2,000	1,500	1,814	2,106	2,484	3,170	3,341	3,921	3,983

Table III: Differential evolution in some of of the groups in French Oceania

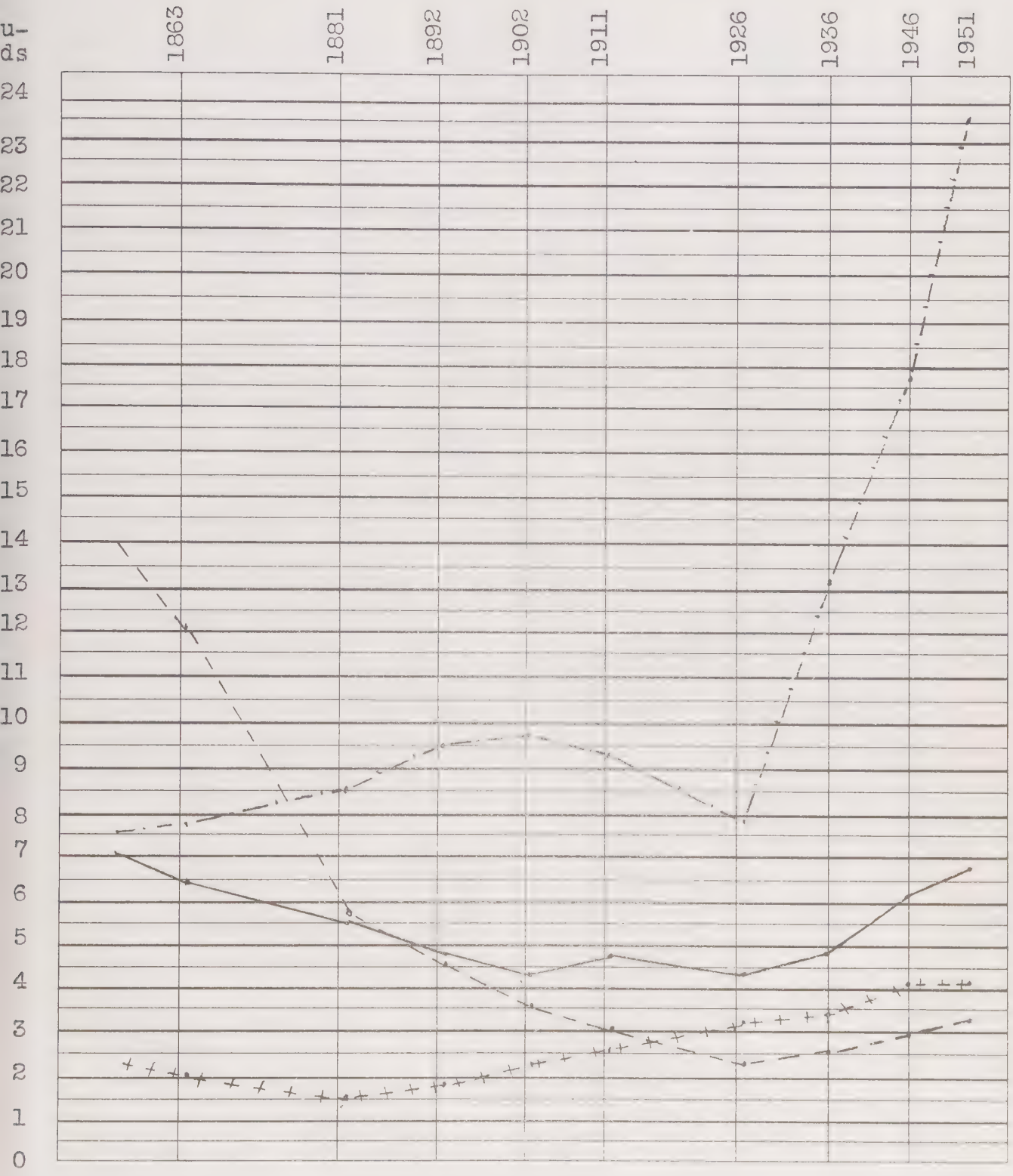
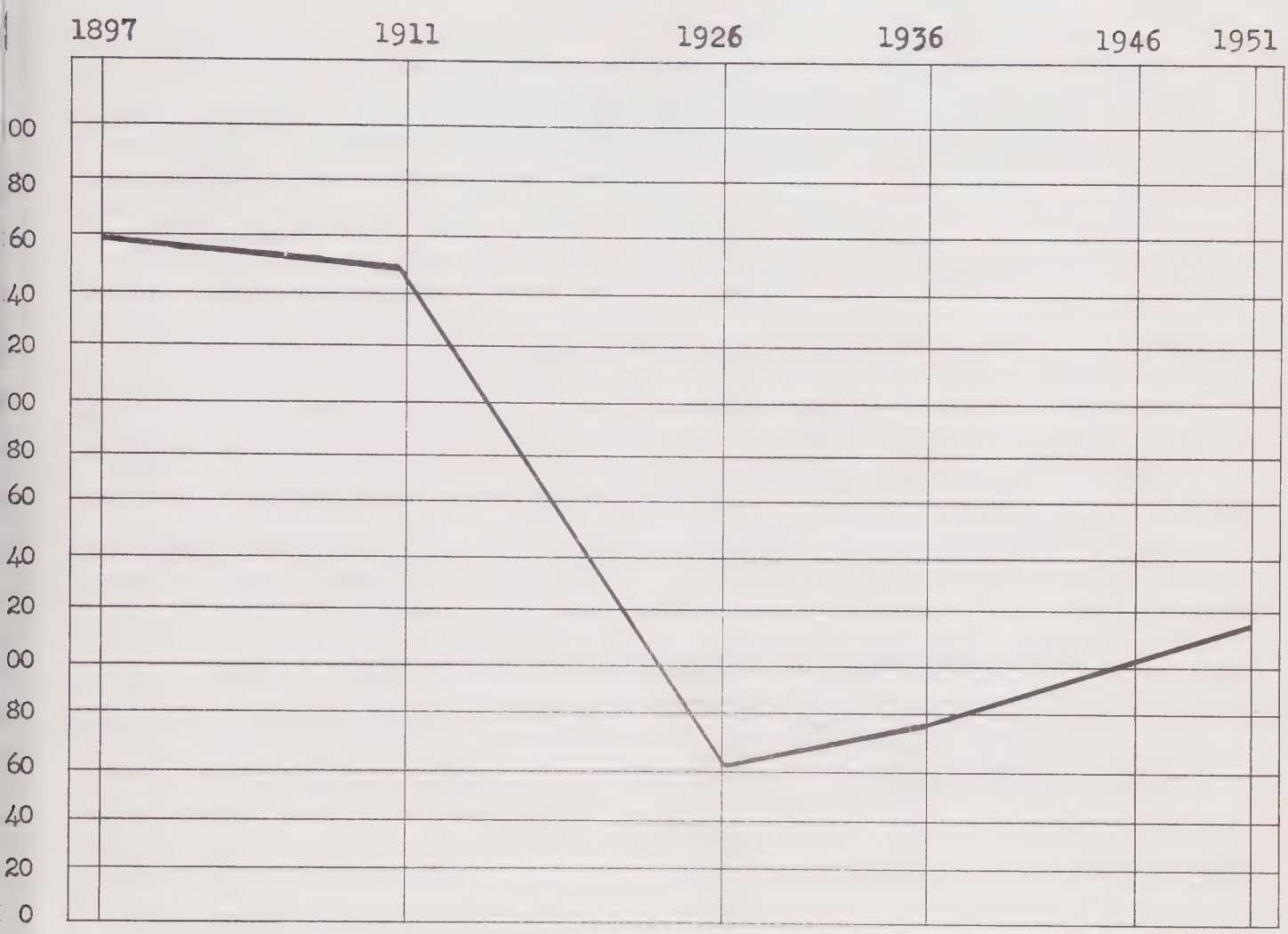


Table IV: Population Changes in Raroia, 1897-1951.



As the figures show, the unexpected native come-back was for French Oceania as a whole very slow until 1926, and thereafter increasingly rapid. (The statistics permit valid comparisons for French Oceania, only from 1902, as previously the Leeward islands were not pacified and no figures are available).

The trend for French Oceania as a whole, is, however, not followed in detail in each of the listed groups, taken separately, and this fact is still better brought out in the graph (Table III). The most striking feature is the varying time at which each group reached the bottom. In Tahiti this occurred in the 1840's (not shown in the graph), in the Austral Islands in the 1880's, in the Tuamotu group around 1900, and in the Marquesas not until the 1920's. The main reason for this differential evolution seems to be the uneven impact of epidemics in the different groups. The Spanish influenza caused, for instance, a downward trend between the 1911 and 1926 census in all the groups, except the Austral Islands!

If we now compare the trend in the Tuamotu group as a whole with that in Raroia, as is done in Table IV, the most significant difference is that the upward trend seems to have started later in Raroia than on the average for the Tuamotus. Whether this is due to prolonged epidemics or migratory movements is hard to say. As to the period prior to 1897 it must be noticed that no accurate census was taken. The estimate in the Annuaire des Etablissements Francais de l'Oceanie for 1863 gives 300 persons for Raroia, which is only slightly higher than the 1897 figure.

Table V: Number of Births and Deaths in Raroia, 1931-1950

Year	Births	Deaths			
		Total	Below 1 yr.	1-20 yrs.	Above 20 yrs.
1931	5	1	0	1	0
1932	5	1	1	0	0
1933	5	2	2	0	0
1934	4	1	0	0	1
1935	5	2	1	0	1
1936	5	1	0	0	1
1937	0	0	0	0	0
1938	5	3	1	0	2
1939	6	1	0	0	1
1940	2	0	0	0	0
1941	8	0	0	0	0
1942	2	2	0	0	2
1943	5	4	2	1	1
1944	2	4	2	0	2
1945	6	3	1	0	2
1946	2	2	1	0	1
1947	2	1	1	0	0
1948	2	1	0	0	1
1949	1	4	3	0	1
1950	5	3	2	0	1
Total	77	36	17	2	17

2. Natural increase, 1930-50.

No detailed population statistics for the individual atolls in the Tuamotu group have ever been published, but in the existing civil register in Raroia we have found complete data as to the number of births and deaths for at least the last 20 years, and they are presented in Table V.

Few comments are needed. The high infant mortality which, expressed per thousand is as high as 220, is of course to a large extent due to an ignorance on the part of the parents of even the most elementary principles of hygiene, but seems also to be a result of the lack of appropriate baby food. As the mothers usually participate in the copra work and take their young children with them to the copra sectors outside the village many of the babies easily catch colds or get pneumonia.

The detailed composition of the permanent population on January 1, 1950, is shown in Table VI. Graphically the composition is pictured below. An interpretation of the facts will be attempted in the following parts of this chapter.

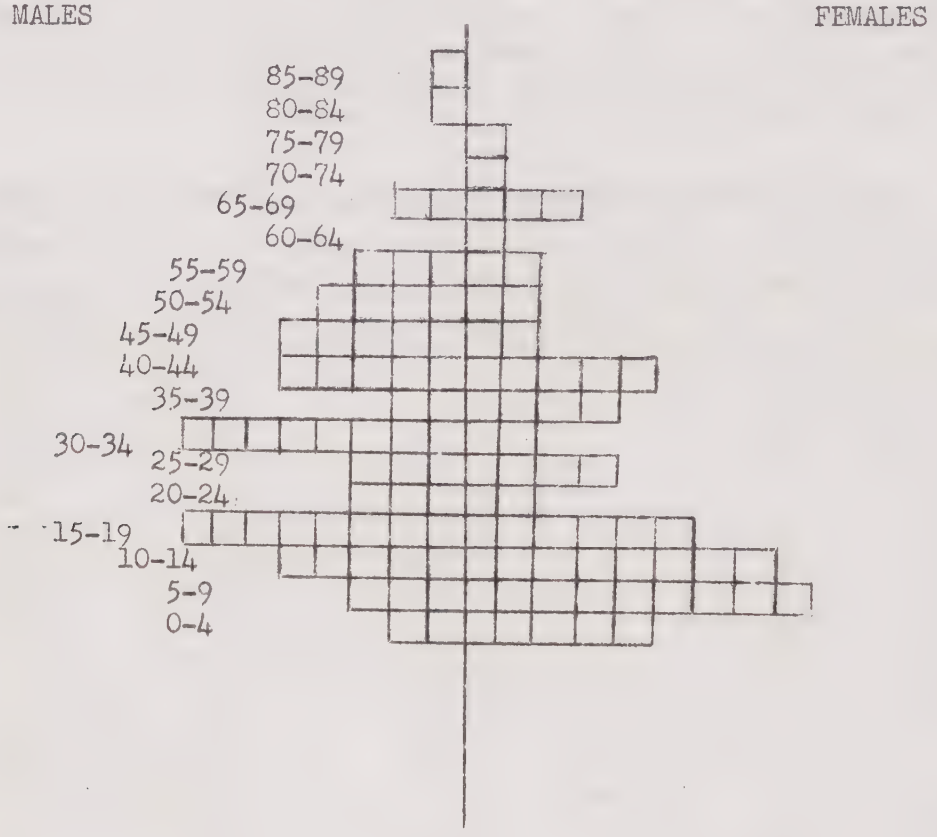


Table VI: Composition of the permanent population as to sex and age, January 1, 1950.

Age	Males	Females	Total
- 4	2	6	8
5- 9	3	10	13
10-14	5	9	14
15-19	8	7	15
20-24	3	2	5
25-29	3	4	7
30-34	8	2	10
35-39	2	4	6
40-44	5	5	10
45-49	5	2	7
50-54	4	2	6
55-59	3	2	5
60-64	0	1	1
65-69	2	3	5
70-74	0	1	1
75-79	0	1	1
80-84	1	0	1
85-89	1	0	1
Total	55	61	116

3. Inter-atoll mobility.

When living in the village on an atoll in the Tuamotus, even for a very short time, one is immediately struck by the continuous changes in the number of persons present. One week the whole population may be there, the next only a handful, a third week only the women or the older people, and so on. As these frequent variations - which of course are not shown in any ordinary population statistics - may be of great significance for understanding the economic and social system, we have also recorded them.

These population movements are of three types:

1. Intra-atoll traveling, i.e. trips to others parts of the home atoll.

2. Inter-atoll traveling, i.e. visits to other atolls.

3. Real emigration or immigration.

The intra-atoll mobility (1) depends in Raroia entirely on the economic activities and will therefore be considered in a later chapter on copra production but the other two types of mobility will be dealt with here.

In order to distinguish between inter-atoll traveling (2) and migratory movements (3), we have recorded not only the actual number of persons in Raroia at the dates of our own censuses, but also all the persons who still could be regarded as permanent residents, i.e. having their home (houses) there. The result is presented in Table VII.

If we compare the permanent population for each year in Table VII with the natural increase during the same period also according to our own records, (See Table V), we get the following series:

Date	Perm.	Actual	Natural Increase
1/1 1950	116	107	-
1/1 1951	118	95	2
1/7 1952	121	101	2
1/7 1953	123	112	4

Some interesting conclusions can immediately be drawn:

1. There is a uninterrupted steady increase of the population, as shown in the column for the permanent residents. This increase would eventually be brought out even if only the number of actual residents were counted (as during the official censuses), but for shorter periods these figures may be deceptive, as seen in the second column.

2. There is very little immigration or emigration, as shown by a comparison between the number of permanent residents and the natural increase.

3. There is a considerable mobility, as shown by the discrepancy between the permanent and the actual population.

The natural increase has been discussed in Part 2 of this section, and the figures here simply show that the general trend noticed for the period 1931-50 continues. The true migratory movement will be dealt with the next part, and some explanations of the figures in the table will therefore suffice here.

During the period 1950-53 there was only one "immigrant", a young man who took up living with a Raroian woman, built a house in the village and seemed intent on staying. This explains the increase of three persons between 1/1 1951 and 1/7 1952, when the natural increase was only two persons. Between 1952 and 1953 the natural increase was four, but two girls went to live with men, elsewhere in French Oceania, and the actual increase is thus only two. If we are to judge from our limited data, some migration to Tahiti is thus going on. The extent of it and the reasons for it will be discussed in the next part.

The general mobility, which is our main concern here, is actually much greater than the figures indicate, as they simply show the balance between the number of departed and returned persons at the given time. If instead we take into consideration not only these figures, but also who was absent at the time of the various censuses, the natives' fondness for traveling is still more evident. The difference in actual population between the 1/1 1950 and 1/1 1951 is 12 persons. The number of persons absent for longer or shorter periods during the year was, however, more than the double, or 29.

Table VII: Composition of the permanent and actual population, 1950-53.

Age	1/1 1950				1/1/1951				1/7 1952				1/7 1953			
	Perm.		Actual		Perm.		Actual		Perm.		Actual		Perm.		Actual	
	M	F	M	F	M	F	M	F	M.	F	M	F	M	F	M	F
0 - 14	10	25	9	25	11	27	10	20	15	28	9	20	17	26	15	25
15 - 29	14	13	13	13	14	13	12	12	14	12	14	12	15	13	12	13
30 - 44	15	11	15	11	15	11	13	11	15	11	16	14	14	12	14	10
45 - 59	12	6	10	5	11	6	9	5	10	6	7	5	9	7	8	7
60 -	4	6	3	3	4	6	2	1	4	6	2	2	4	6	3	5
Total	55	61	50	57	55	63	46	49	58	63	48	53	59	64	52	60

Table VIII: Number of Raroians visiting Papeete in 1950.

Age	Jan.		Febr.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
0 - 14	1	1	0	2	0	2	0	2	1	3	1	0	1	0	1	1	0	1	1	6	1	6	1	6
15 - 29	0	0	1	0	0	0	2	1	1	0	0	0	0	1	1	1	2	2	3	2	2	2	2	2
30 - 44	1	0	1	0	1	0	1	0	1	0	0	1	0	0	0	0	1	1	4	2	4	2	4	2
45 - 59	3	3	2	1	3	3	2	2	1	1	1	1	0	2	1	0	1	1	1	0	1	0	1	0
60 -	0	2	1	0	0	2	0	1	0	1	1	1	1	1	1	3	0	3	1	2	1	2	1	2
	5	6	5	5	4	7	5	6	4	5	3	2	2	4	4	5	4	8	10	12	9	12	9	12
	11		10		11		11		9		5		6		9		12		22		21		21	

Some of our other data are still more eloquent. Between January 1, 1950 and July 1, 1952, for instance, the following changes took place:

Out of the 107 persons on the atoll on January 1, 1950, 22 were elsewhere in French Oceania in July 1952, and 6 were dead.

On the other hand, on July 1, 1952 there were on the atoll 14 persons (Raroians and others) who lived in or visited other islands on January 1, 1950. The number of births was 10.

If we went only by the absolute figures in table, the difference between the figures for 1950 and 1952 is 6 persons. As a matter of fact, the total number of persons, who have been away from Raroia during these two and one-half years is at least 36 (22 + 14)!

Of the 29 Raroians visiting other islands in 1950, 25 had Tahiti as their destination. The main reasons for undertaking a voyage to Tahiti, which may take anywhere from five days to two weeks (see Chapter III), are in probable order of importance:

1. A desire for a change and diversion.

2. Necessity of medical treatment.

3. Legal matters which must be settled.

4. A wish to see relatives.

There seems to be a seasonal pattern for these visits if we are to judge from the data collected during a single year and presented in Table VIII. The increased number of visits towards the end of the year is certainly due to the fact that the months of November and December is an off-season immediately preceeded by copra work in the most productive sector (see Chapter V). The Raroians then have considerable money and no imperative duties. The length of a visit to Tahiti is rarely less than one month, and often it is prolonged for several months or even half a year, but the limited data we have does not permit any far-ranging conclusions.

The visiting between Raroia and Tahiti is pronounced but natural with the paramount importance of Papeete. The Raroians are practically never visited in return by their relatives living in Tahiti, and other Tahitians than those employed on the schooners rarely have reason for visiting an atoll. The few Tahitians living in Raroia in 1950 were either married to Raroians or temporarily employed as workers by wealthy local landowners (see Chapter VII).

Only four of the 29 Raroians who visited other islands in 1950 had an atoll in the Tuamotus as their destination. It must be noted, however, that the frequent visits to Takume, the only atoll which can be reached by existing canoes and boats in Raroia, are not included in this figure. Neither have we recorded the great number of visits from Takume to Raroia.

It is surprising that so little visiting is going on between Raroia and the other atolls in the group (except Takume), in spite of the fact that there

is a great deal of intermarriage (see next part). The explanation might simply be that Tahiti is the common meeting-ground for natives from all the atolls, and that it always is difficult to secure a passage both ways within reasonable time between Raroia and other atolls.

4. Migration and intermarriage.

The figures in the previous sections indicated that some real migration occurred, although the period for which we had data was too short to permit any general conclusions as to its extent. The only way to get any additional information and the necessary time perspective seems to be to investigate the geographic origin of the population and to study family stories, both of which methods we have tried. The geographic origin, defined as the home-place or permanent residence of the parents, is shown in the following table:

Table IX: Geographic origin of population, 1/1 1950.

Origin	Male	Female	Total
Raroia	34	43	77
Tuamotu	5	8	13
Tahiti	9	5	14
Moorea	0	1	1
Raiatea	2	0	2
Total	50	57	107

There are thus 16 "foreign" men and 14 "foreign" women in the atoll, all from the Tuamotus and the Society Islands, or from two out of the five groups in French Oceania. That there is no intermarrying with the Marquesas is not too surprising, as the natives of this group speak their own local dialect and have somewhat different customs, but why the Austral Islands and Mangareva are not represented is difficult to explain.

If we now consider the marital status of these "foreigners" we find the following. Out of the total number of 16 "foreign" males, 13 are married to Raroian women, 1 is the widower of a Raroian woman, 1 is an adopted baby, and only 1 is married to a woman who is also a "foreigner". Out of the total number of 14 "foreign" women, 8 are married to Raroian men, 2 are widows of Raroian husbands, 3 are adopted young girls, and only 1 is married to a "foreign" male.

Immigration into Raroia is thus intimately linked with marriage. This intermarrying has probably been constant over the years, which is shown by the fact that of these 24 marriages between a Raroian and a "foreigner" (13 ♂ 1 males and 8 ♂ 2 females), 15 were contracted more than 10 years ago and 9 since then.

A corresponding emigration is going on all the time, too, as a perusal of the family stories and genealogies indicates, but the extent of it is of course impossible to ascertain with the same exactness, and we have not tried to compile any statistics.

The main reason for these frequest inter-atoll alliances is the continued operation of the pre-European incest rules, which forbid marriage between all persons more closely related than third degree cousins. As the population is small, most families are closely related and the common practice of adoption, which has the same force as actual blood ties, still further reduces the number of "unrelated" people, the possibilities for an individual to find a sexual mate and marriage partner in the home island are thus considerably limited. The same conditions are prevalent on all the other atolls in the group, and there is therefore every reason to suppose that in the long run the emigration from Raroia is compensated by an equally extensive immigration to the atoll.

The residence rule is bilocal and neolocal, and the actual choice of dwelling place seems to a large extent to be determined by economical considerations, i.e. the home atoll of the partner who possesses the more land is usually preferred. In all probability both sexes are therefore represented in approximately the same number among the emigrants. This is rendered still more likely by the fact that the number of male and female immigrants is roughly the same for the period covered by Table IX.

5. Race mixture.

An inevitable result of the frequent intermarriages between Raroians and other islanders is of course a progressive race mixture. In section A. 2 of this Chapter the number of mixed Polynesians in Raroia was, according to the census of 17/18 September 1951, only 12, while the remaining 97 natives were listed as pure-blooded, and the number of Chinese was 2.

These figures were based solely on the verbal declaration of each person, and thus of doubtful reliability. We tried therefore to determine the number of mixed persons on a more exact basis, viz. the pedigree of each individual. Contrary to the situation in other parts of French Oceania, the islanders in the Tuamotus (especially in the eastern half) almost all possess genealogies going back at least to the time of the first contact with other racial groups. We have gone over each individual's pedigree in Raroia and marked off all persons of non-Polynesian extraction, and, depending on the nearness to these ancestors, the degree of intermixture has been fixed for every islander present on January 1, 1950.

Persons who did not know their genealogies (mostly Tahitians) and Tahitians found in the pedigrees have arbitrarily been counted as having 1/8 foreign admixture. Persons with less than 1/8 foreign admixture have been counted as pure Polynesians. There may still be some hidden intermixture, but as the islanders seem to keep track of all adulterous children and usually without hesitation indicate the real father, this source of error is negligible.

The result of the classification of the Raroians according to this considerably more rigorous, although of course not completely satisfactory, definition of racial purity is shown in the following table:

Table X: Racial composition of the population on January 1, 1950.

Race	Males	Females	Total
Pure Polynesian	34	39	73
Pure white	0	0	0
Pure Chinese	1	0	1
Mixed Polynesian-White	14	15	29
Mixed Polynesian-Chinese	1	1	2
Mixed White-Chinese	0	2	2
Total	50	57	107

The number of mixed persons is thus altogether 33, or almost three times higher than the figure based on the verbal declarations, which was 12 (see Section A, part 2). That the mixed persons are justified to a large extent in identifying themselves with the group of pure Polynesians is however proved by the fact that the admixture is very slight in most cases, as shown in the following table.

Table XI: Extent to which the mixed persons are Polynesian, Jan. 1, 1950.

Degree Polynesian	Males	Females	Total
7/8	5	5	10
3/4	2	7	9
1/2	5	4	9
1/4	3	2	5

The many varying degrees of intermixture show that the intermarrying between the various racial groups has gone on for a considerable time. A still better way to follow the trend backwards is simply to classify all the mixed persons according to age, which is done here:

Table XII: Age of the mixed persons in Raroia, January 1, 1950.

Sex	Age			Total
	0-14	15-44	45-	
Male	2	10	3	15
Female	9	6	3	18
Total	11	16	6	33

The distribution of mixed bloods over all three age classes in a number roughly proportionate to the total number of persons in each age group (see Section A, part 4), shows definitely that racial mixture first appeared several generations ago, and that it still occurs to a large extent. It is very likely that this process evenutally will lead to the same thorough changes of the islanders' physical characters as those which have taken place in so many other Polynesian groups.

This logically brings up the question of how representative are physical measurements taken today on living Polynesians for determining the racial type of the pre-European population. We have measured the total adult population and shall present the result in a separate study. No attempt will therefore be made to discuss this problem here. It may, however, be worth while mentioning that the cephalix index is considerably lower for the group of individuals classified as pure Polynesians according to our criterion than for the total number of adults in the atoll.

ANNUAL CYCLE OF EVENTS IN 1950

January	1st	Sunday. Whole population in village.
	2 - 10	Repair work on the wharf and preparations for an expected visit by the governor. Rains and calm.
	13	The administrator of the Tuamotu group visits Raroia.
	middle	Some of the islanders begin to prepare copra in the Raro sector on the southwest side of the atoll.
	16	Schooner loads copra.
	21	Schooner loads copra.
	end	Half of the population works in Raro.
February	beginning	Strong wind. Between half and three fourths of the population works in Raro.
	middle	Heavy rains.
	16	Schooner loads copra.
	22	Schooner loads copra.
March	beginning	The work in Raro continues.
	19-21	Schooner loads 18 tons in Raro, the whole population back in village for several days. Many persons drunk.
	end	Work continued in Raro.
April	1st	Whole population back in village for Easter.
	2 - 7	Complete calm.
	6	Two schooners load copra.
	7	Good Friday.
	10-11	Three schooners load copra.
	end	First shoals of Selar crumenophtholmnus appear, and many postpone their departure to Raro.

May	beginning	About a fourth of the population works in a new copra sector, Gake.
	7 - 8	Schooner loads copra.
	15	Schooner loads copra.
	14	Jeanne d'Arc celebration. The whole population in village.
	middle	Numerous shoals of Selar crumenophtholmnus. Heavy rains and winds.
	18	Ascension Day. The whole population still in village.
	end	Most people back in Gake.
June	whole month	Shell diving by a small number of men.
	beginning	A few families continue the work in Gake
	3 - 6	Three schooners load copra.
	7	The missionary arrives. The whole population in village.
	16	Schooner loads copra.
	18	De Gaulle Day celebrated. Restaurants and wheel of fortune. The celebrations continue a week.
	second half	The turtles begin to appear.
	27 - 30	Schooner loads copra in Gake.
	30	Communion for the children. The whole population in village.
July	whole month	Shell diving by a small number of men.
	beginning	Strong wind. The whole population stays in village waiting for better weather and provisions. Turtles frequently caught.
	middle	No food and very little water left. Most people live on fish and coconuts.
	14	French National Day celebrated. Restaurants and wheel of fortune continue a week.
	23 - 24	Schooner arrives with provisions.
August	beginning	Some families return to work in Raro. Many men chase turtles.
	15	Assumption celebrated. The whole population in village.
	18	The missionary leaves.
	end	Calm. Impossible to return to Raro. The men on turtle hunt.

September	1st	Schooner loads copra. Visit by the deputy.
	12	The administrator of the Tuamotu group visits Raroia. The whole population in village.
	middle	The turtle season over.
	rest of the month	Three fourths of the population works in Raro.
October	beginning	Three fourths of the population still in Raro.
	15 - 19	Two schooners load copra. Everybody plays card. Many drunk.
	end	Most islanders work again in Raro.
November	whole month	The lands around the village worked. Everybody permanently returned to the village.
	8 - 10	Schooner loads copra.
	middle	Bird catching and egg collecting begin and last until the end of the year.
	11	Armistice Day celebrated. Wheels of fortune and restaurants. The celebration continues two weeks.
	end	Strong wind.
December	whole month	Everybody in village making copra on the adjacent lands.
	middle	Rest period.
	20	Christmas celebrations begin and last until the end of the year.

Schooners calling at Raroia in 1950.

The schooner calls are such important events in the annual cycle and play so vital a part in the islanders' lives, that we have decided to present here separately the complete data on the frequency of the schooner communications with Papeete.

There is no boat or schooner in Raroia seaworthy enough to carry people or freight to Papeete, and the few canoes or boats in existence can not even be used for visiting other atolls in the Tuamotu group with the exception of the neighbour atoll of Takume. The Raroians depend therefore for traveling and transport exclusively on the trading schooners belonging to private owners or (in one case) to the Tuamotu Co-operative Society.

The total number of boats calling at Raroia in 1950 was 38. Of these three were administration schooners and one a naval hydrographic ship. The Raroians had thus 34 opportunities to sell copra and to buy merchandise. (Which was more than enough from the commercial point of view as the islanders had copra to sell only to 24 of the schooners.)

All the trading schooners have their base in Papeete and return there after each cruise to unload the copra and take aboard a new stock of merchandise. This does not necessarily mean that the islanders had 34 opportunities to go to Papeete during the year. Practical and economic considerations reduce seriously this number. A trading voyage to the Tuamotus usually lasts from four to six weeks, and in some instance when the schooner visits also the Marquesas or Mangareva, it takes at least two months. Since the passengers pay so much per day for their transportation, the itinerary of the schooner after it leaves Raroia is of considerable importance. Thus it can be seen that all the schooner calls cannot be regarded as of the same value to the islanders, and we have therefore classified them according to the practical opportunities to travel which they offer. (See Table XIII.)

Let us first consider the opportunities to take passage from Raroia to Tahiti. The important factor here is of course the length of the voyage, and we have therefore separated the 34 schooners calling at Raroia into two groups: Those which call at Raroia at the beginning, and those which call at Raroia towards the end of their cruise. (Called respectively "Coming" and "Returning".) If we disregard all the schooners in the first category, as the Raroians do themselves, the number of opportunities to go to Papeete is immediately reduced to 14. (Whether the schooner's call is announced beforehand over the radio is of no importance in this case, as the islanders are ready to leave at any time.)

The number of occasions to travel in the opposite direction, from Papeete to Raroia, must also be reduced. None of the schooners follows a regular schedule or a fixed itinerary, but the atolls where the schooner is to call are announced for each voyage over "Radio Tahiti". Depending on the circumstances and information gathered during the cruise the itinerary, may, however, be changed, some atolls by-passed and additional ones visited. For Raroians who want to take passage from Papeete the only communications on which they can depend are of course the schooners which have announced that they have included Raroia in their itinerary, and the fact that other schooners may call there eventually does not help them the slightest. When the announced schooners coming from Papeete are separated from the unannounced ones, the number of practical opportunities for transportation is reduced from 20 to 12.

For Raroians who wanted to go to Tahiti in 1950 there was at least one schooner a month, except during the months of July and December, and the average number of opportunities per month was 1.2. For Raroians who wanted to return to their home island from Papeete, there were no schooners during the months of March, May, July and August, and the monthly average was only 1.0.

These relatively rare and irregular communications with Papeete are certainly to a large extent the cause of the retarded development of certain aspects of the economic and social life in Raroia. The results of these "lags" will, where possible, be studied in their relation to the culture as a whole in subsequent chapters.

Table XIII: Number of trading schooners calling at Raroia in 1950.

Month	Total	Coming from Papeete		Returning to Papeete	
		Announced	Unannounced	Announced	Unannounced
January	4	1	2	-	1
February	3	1	1	1	-
March	2	-	1	-	1
April	6	2	2	-	2
May	3	-	-	1	2
June	5	3	-	-	2
July	1	-	1	-	-
August	1	-	-	1	-
September	4	2	1	1	-
October	2	1	-	1	-
November	2	1	-	-	1
December	1	1	-	-	-
Total	34	12	8	5	9

Chapter IV

LAND OWNERSHIP

1. Historical background.

The problems of land ownership are serious and extremely complex in Raroia as everywhere else in the Tuamotus, and a special study would be required in order to throw full light on them. We have lacked the time for this, and the following is therefore only a rapid survey of the situation with some general observations.

At the root of all difficulties is undoubtedly the rapid change of the economic system without corresponding necessary adjustments in land usage and ownership. Before the rise of the copra trade, each atoll was divided into districts, which belonged to the extended family units, and even if there was some rivalry over the food resources, certainly no disputes occurred within each district concerning the land itself.

When, however, during the second half of the last century (see Chapter I), the natives began to realize the value and advantage of making plantations of coconut palms, they also gradually became "land-conscious" and wanted to secure the exclusive rights to the profit from the lands they had planted. This created considerable friction, and the situation soon became very confused.

When France finally established undisputed sovereignty over the Tuamotus in 1880, an attempt was immediately made to create order and to introduce legal procedures. Committees of prominent natives were created in all the atolls - in Raroia in 1883 - which were to examine thoroughly the question of land ownership.

The basic principle governing the work of these committees was that legal title to land should be given only to the individual who could prove by reciting his genealogy that he belonged to the extended family, which occupied that land in pre-European times. When there were conflicting claims, the ownership was to be attributed to the person with the closest genealogical affiliation with the founder of the lineage occupying the disputed land. This principle was generally respected by the natives, and the genealogies for each district were officially recorded in public books, which henceforth were to be the basis of all land settlements.

The committees were furthermore charged with the task of making accurate surveys and determining the boundaries of each parcel. (A work for which they were poorly equipped and prepared and therefore could not perform properly.) In each case the documents were sent to the Land Bureau in Tahiti, and once confirmed by publication in the official journal and registered at the bureau they had legal validity.

This arrangement seems at first glance adequate, but a basic injustice was inherent in it. Many epidemics and diseases had already ravaged the group, and a great number of people had died in Raroia as elsewhere in the Tuamotus.

The population decrease was naturally not proportionate in all the different districts into which the atoll was divided. Thus while in one district only some few persons had survived, in an other of approximately the same size, there were perhaps ten times as many survivors. As assigning of land titles was based on genealogical affiliation with the lineage occupying the district, in the former case each individual got a considerable piece of land, whereas in the latter, the allotment for each individual was diminutive.

Leaving the question of equitable distribution aside, the problem seemed nevertheless to be satisfactorily resolved. New difficulties arose soon, however, and they were principally of two kinds:

1. Due to the instability of the marriages, the complexity of the relationships and the uncertain status of the various children (legal, illegal and adopted), the inheritors preferred in many cases to cultivate the land in common in accordance with old native custom. In this way the clear titles established in 1883 were already confused after one or two generations.

2. In other cases the existing land was carefully divided up among all inheritors, which meant that the land parcels continuously increased in number, grew smaller and became more widely scattered. A family which in one generation applied this principle, might in the next adhere to the first, which of course did not make the situation any better.

The only possible remedies would have been: in the first place to settle the inheritance questions after each death, and in the second place to redistribute and concentrate the land holdings through buying and selling. These solutions, which are applied regularly in countries with Western economic and legal systems, have not been tried by the natives. The reasons for this are probably the following:

1. The natives have still not adopted a commercial attitude towards land, but regard it as inalienable, as did their ancestors.

2. Many of the land surveys made by the committees in 1883 were faulty and could never be used as a basis for commercial transactions.

3. Many of the titles established in 1883 were never registered for one reason or another, and others were lost at the Land Bureau in Papeete during the cyclones of 1903 and 1906. Therefore no one knows any longer who is the owner of these lands, and they can not be traded.

4. The natives are completely ignorant and even suspicious of Western legal procedures. Furthermore they have to go to Papeete each time, even for legalizing a will, which makes them still less inclined to have recourse to the law.

The situation has gradually deteriorated, and today the atoll is split up in innumerable parcels of iridculously small size; each owner's land holdings are extremely scattered and very few Raroians have clear titles or any titles at all to the land they use. As a result there are many disputes, much time is lost in traveling between the scattered lands, and long stretches of land are not planted, as nobody knows who the owners are. When we subsequently speak of ownership, de facto occupancy is thereby meant.

2. Present situation.

The total number of land parcels outside the village, where the conditions of course are different, is in Raroia approximately 1,000 for a total vegetated area of 921 hectares. Theoretically the barren parts of the atoll rim have owners, too, but as nobody is interested in these portions and no reliable information concerning ownership could be obtained, they are not included in the total number of land parcels above.

Of the 921 hectares of vegetated area, 334 are covered with other vegetation than coconut palms (see Chapter I), which probably indicates the approximate proportion of disputed lands or lands without known owners. The average size of each parcel is thus less than one hectare, and few seem to surpass or fall below this figure. There are maybe 20 or 30 land holdings bigger than 2 hectares, but on the other side, even many of the 75 islets with a vegetated area smaller than one hectare are divided up between two or more owners.

The greatest land holdings exist on the five big islets with the notable exception of the islet where the village is situated. We have surveyed three of these islets: Tetou on the east side of the atoll, Teputaiti, south of the village, on the west side, and the whole stretch of land north of the village. The figures for these islets are:

Tetou	18 hect.	19 parcels
Teputaiti	63 hect.	52 parcels
North of the village	27 hect.	63 parcels

How much land, measured in hectares, each individual owns unfortunately can not be computed with any exactness, as no detailed map of the atoll exists and titles are lacking for a great number of lands as mentioned above. In order to get at least a rough idea of the distribution of the land, we have chosen to use as a basis for our estimate the amount of copra produced by each adult individual on his own lands during a year. As these figures are complete and reliable, we think that they give a better picture of the situation, than simply a list of the number of land parcels owned by each person.

Table XIV shows the annual production of copra for each adult individual (above 20 years of age) in Raroia.

Table XIV: Land holdings in Raroia as judged from production figures.

Annual production in tons	Number of producing		Total number of persons	Total number of tons
	Males	Females		
0	16	13	29	0
1	2	1	3	3
2	3	2	5	10
3	2	4	6	18
4	2	3	5	20
5	2	2	4	20
6	2	2	4	24
7	3	0	3	21
8	1	2	3	24
9	3	0	3	27
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	1	0	1	13
Total	37	29	66	180

The difference between the total annual production of copra, 187 tons (see Chapter V, 8), and the figure above, 180 tons, is due to the fact that some few individuals who own land in Raroia live elsewhere in French Oceania. But as a person, who migrates to another island, as a rule can not depend on his remaining relatives to send him money from the produce of his lands, the actual number of absent land owners is probably somewhat higher than the statistics indicate.

The group of landless persons is principally made up of "foreigners", i.e. natives from other islands in French Oceania, married to Raroians. The only exceptions are two "foreigners" who were adopted young and given land. A yound Raroian man or woman customarily receives a parcel of land from his or her parents when marrying, and as the Raroians marry young, all men and women above 20, with one exception, also have their own lands.

3. Concrete examples.

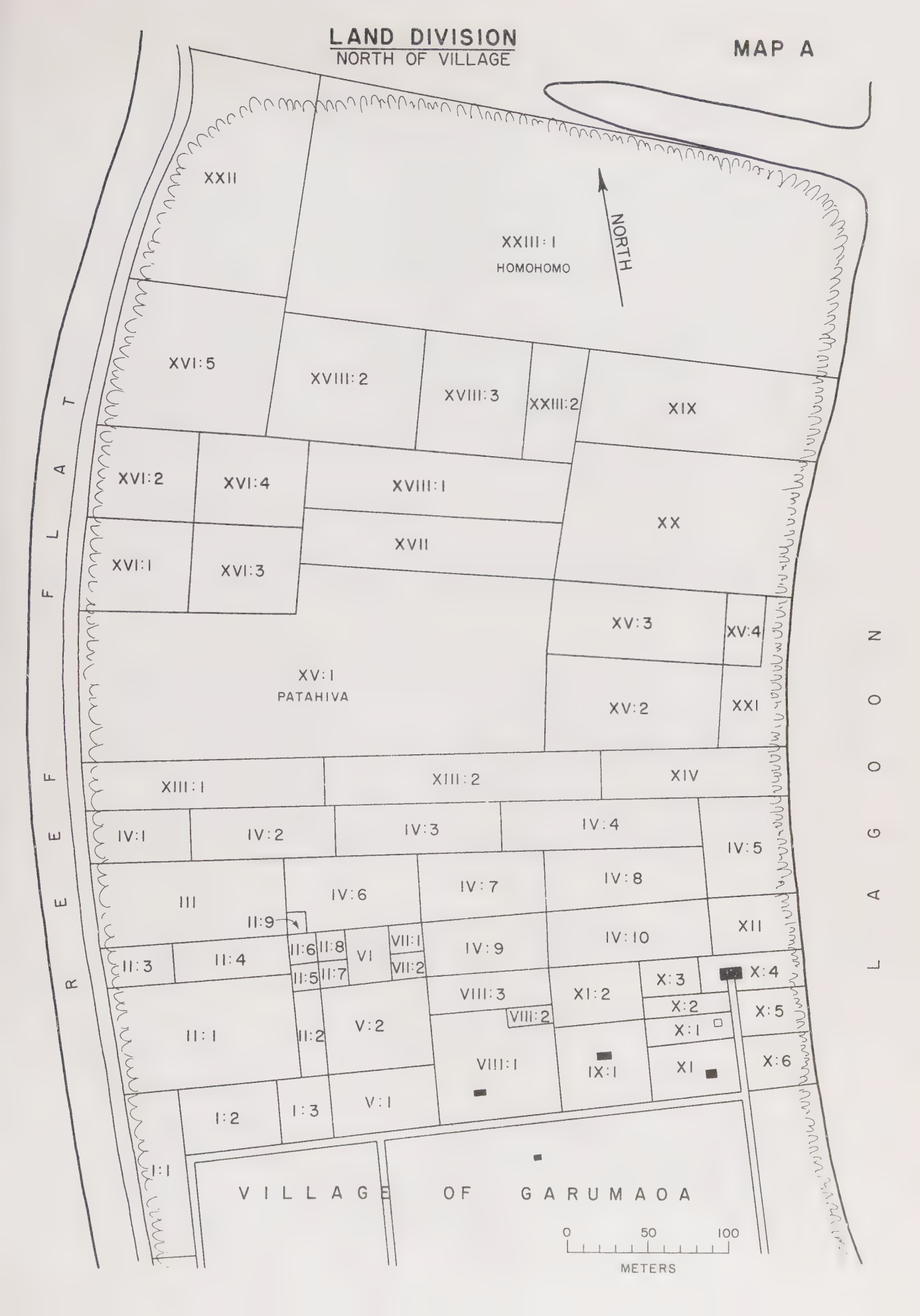
In order to give a concrete example of how confused the land question is in all its aspects, we include finally here more detailed data for one section of the atoll. The section is the northern part of the islet on which the village is situated, and it measures roughly 450 x 600 meters. We surveyed it simply by pacing in company of the members of the village council who indicated the boundaries of the land holdings. The result is shown on the accompanying map (Map A).

The total number of land parcels for this section, measuring 27 hectares, is 63. Many of the parcels have identical names, and altogether there are only 23 names for these 63 parcels. This fact seems to indicate that larger land units have been divided fairly recently. This is also the opinion of the natives, who claim that the splitting into smaller units has occurred since the official survey in 1883.

In order to verify this and to study more in detail the changes which have taken place since 1883, we have searched through the entire register for Raroia at the Land Bureau in Tahiti. That the register is incomplete was immediately shown by the fact that titles for only 19 land parcels in the chosen section were found. These 19 parcels totalled roughly 10 hectares, whereas the section actually measures 27 hectares! For almost two thirds of the land there are thus no titles at all.

Of the 23 land names in use today 8 were found in the register, and the number of parcels with identical names were in 1883 and 1950 respectively:

Land on the map no.	Number of parcels	
	1883	1950
IV	3	10
V	1	2
X	3	6
XV	1	4
XVI	3	5
XIX	2	1
XX	3	1
XXIII	1	2
Total	17	31


LAND DIVISION
NORTH OF VILLAGE
MAP A
NORTH
XXII
XXIII:1
HOMOHOMO
XVI:5
XVIII:2
XVIII:3
XXIII:2
XIX
XVI:2
XVI:4
XVIII:1
XX
XVII
XVI:1
XVI:3
XV:3
XV:4
XV:1
PATAHIVA
XV:2
XXI
XIII:1
XIII:2
XIV
IV:1
IV:2
IV:3
IV:4
IV:5
III
IV:6
IV:7
IV:8
II:9
XII
II:3
II:4
II:6
II:8
VI
VII:1
IV:9
IV:10
II:5
II:7
VII:2
X:3
X:4
VIII:3
XI:2
X:2
X:5
II:1
II:2
V:2
VIII:2
X:1
VIII:1
IX:1
XI
X:6
I:2
I:3
V:1
I:1
VILLAGE OF GARUMAOA
0
50
100
METERS
REEF FLAT
LAGOON

That a considerable fragmentation really has taken place during the last 70 years is thus amply demonstrated for our sample, and everything seems to indicate that this is a general trend in Raroia, and probably also in the Tuamotus as a whole. Subdivision of lands had, however, in all likeness also occurred in post-White time previous to 1883, as the situation already then was at variance with the old Polynesian principle: one land - one name.

Out of the 17 land parcels for which titles were found in the register, 16 had single owners, and one had three brothers as owners in 1883. The situation was thus surprisingly clear at the outset, but during the intervening 70 years it has become so confused that it now is almost impossible to trace the history of many of these parcels with certainty.

We have interrogated all the individuals at present regarded as owners of the 63 parcels into which the section (Map A) is divided. They are at least 150 in number - we gave up at this point of sheer exhaustion - but many of them are of course identical, as the same person frequently claims more than one parcel. It would be useless to repeat the explanations of each individual as to how he establishes his claims, as they are too conflicting and fragmentary, and we shall therefore only give a few examples.

Let us for instance take land no. IV (Map A) and cite the case stories of a couple of parcels:

Parcel 1 is owned by a person "A" and his sister who lives in Takume. Their right is, however, violently contested by three second degree cousins. "A" makes the copra, but does not send any money to his sister. He has no title to the land.

Parcel 2 is owned by a woman who received it in the following way: Three generations ago there lived in Raroia a couple who possessed a great number of lands. The two daughters "B" and "C" inherited all the lands, but did not divide them up between themselves. "B" died first and left four children, but her sister "C" took control of all the lands. "C" had no children and before she died she distributed the lands among her nieces, the four daughters of "B". The first received 30 parcels (among them the one in question), the second 27, the third 6 and the fourth 5. The reason for this unequal distribution is said to have been that the two first nieces were the favorites of "C". The husband of "C" received nothing. He is still alive but does not seem to have any objection to the arrangement. No title exists.

Parcel 4 is owned by a single person. There is a title to the land, or at least a title, which with some benevolence could be interpreted as describing this parcel, but the owner is not able to prove his relationship with the original owner, in whose name the title is issued.

Parcel 5 is disputed by half a dozen persons with conflicting versions of the legal and genealogical facts.

And so on and on ad absurdum.

It is of course outside the scope of the present study to try to indicate definite solutions to the problem, but it must be mentioned that a prescription law, granting title to a person after 30 years of uninterupted and uncontested occupancy of land, has been applied elsewhere in French Oceania in troublesome cases. Such a solution requires, however, first a detailed land survey and careful examination of the situation.

Chapter V

SURPLUS PRODUCTION

The main feature of the economic system in Raroia is the extreme dependence of the population on one single source of income, the copra crop, and the startling degree to which the islanders have abandoned the old direct subsistence activities in favour of a surplus economy. It is therefore only logical to begin the description of production in Raroia with the activities directed at the creating of a surplus, and leave the treatment of the other economic activities until a later chapter.

Due to the infertile soil and the limited natural resources there are few products of an atoll like Raroia on which a surplus economy dependent on the world market could be based, and the only ones which have been tried so far are the sea slugs, the mother of pearl shells and the copra. Of these the copra has gradually become of paramount importance. For almost a century beginning in the 1830's there was a regular export of sea slugs, and many natives in Raroia and other atolls regularly dived for and prepared sea slugs for export. Since the last world war the Chinese market has, however, been closed, and the consumption of the local Chinese population in French Oceania (about 7,000) is so limited that nobody finds it worth-while to collect sea slugs any more.

A. Mother-of-Pearl Shell-Diving.

The diving for mother-of-pearl shell began almost simultaneously with sea slug collecting, but whereas the sea slug collectors worked individually and sold their product to the traders, the pearl shell collecting was organized largely by foreign merchants, who hired natives to do the diving. In the beginning the numerous pearls were a more important source of income than the shells themselves, but today pearls are extremely rare, due to the frequent diving, and a negligible source of income.

There is some danger that the supply of shells may become exhausted. Strict measures have been necessary to preserve the beds. Diving is permitted now only at certain atolls during limited periods in well defined sectors. As the shells grow only under specific conditions they are not found everywhere in the group. The actual number of highly productive lagoons (above 100 tons per season) is not more than five. The number of lagoons of secondary importance (among them Raroia) is seven. In Raroia diving is, however, difficult as the lagoon is rather deep, 75-150 feet, and only the most skilled divers can share in this source of incoem.

Sometimes during the open diving seasons a limited number of natives from other atolls come to Raroia in order to participate in the diving, and the last time this happened in 1947 the total amount of shell gathered was 11.7 tons. The Raroians contribute, however, only a small proportion of this amount. The number of Raroians diving during the two months the season lasted in 1950, when no natives from other atolls participated, was only eleven. The total amount of shells collected was 2,742 kgs, or an average of 236 kgs per diver. Since the sums earned in this way are insignificant (in spite of the

high 1950 price of 30 francs a kilo) compared to their copra earnings, the men do not take this diving in the home atoll seriously, but combine it with fishing or do it mostly for fun.

Like all other natives in French Oceania, the Raroians may participate in the diving permitted seasonally every year in certain of the other atolls in the Tuamotu group. As a rule few of them find it worth while, in spite of the huge sums a good diver can earn. When the neighbouring atoll of Takume is open for diving, however, almost the whole population migrates there. The reasons for this preference for Takume are very simple. The atoll is so close to Raroia that it can be reached with outrigger canoes, and the lagoon is so shallow that even inexperienced divers and women can participate. Furthermore it is enclosed, which means that there are no dangerous sharks.

No diving occurred at Takume during 1950, when most of the data for the present study were collected, but in July-September 1952, when we revisited the atoll with the other members of the Pacific Science Board's team, diving was going on, and we gathered some additional information.

The tendency to migrate to Takume in whole family groups seemed very pronounced, as seen by the following table showing the number of Raroians living in Takume during the middle of the diving season, on September 8, 1952:

Age	Males	Females	Total
0 - 14	5	14	19
15 - 29	9	8	17
30 - 44	13	9	22
45 - 59	5	3	8
60 -	2	1	3
Total	34	35	69

About two thirds of the total population of Raroia lived at this time thus on Takume, and all except the children below 14 were more or less actively engaged in the diving. Those left behind in Raroia were mainly small children and old people.

The income derived from diving is good by any standard. An adult male can collect between 50 and 100 kilos of shells per day, and a woman or younger man at least half that amount. We have no exact figures for the total income of the Raroians, as we visited Takume only once. The diving was still going on when we left, but we have tried to make a rough estimate based on information volunteered by the divers themselves.

As a rule the divers do not stay the full season of four months on Takume, but relax from time to time and return to Raroia. Between 45 and 60 days of actual diving per individual per season is therefore a fair guess. As

As the price paid for the shells varied between 30 and 45 francs a kilo, a good diver should have earned around 200,000 francs ($3,175) and a woman or young man half that sum during a season.

It must, however, once more be stressed that the diving is a strictly seasonal activity; that the prices fluctuate greatly; and that most of the money earned is immediately spent. In spite of the big occasional income a Raroian may derive from shell diving, it plays nevertheless a subordinate part to copra growing and preparation in the economic life of the islanders.

A special study of the diving is highly needed, not only from the economic point of view but also for clarifying certain social processes, as a great deal of acculturation takes place during visits to atolls during the diving season. The limited time and the concentration of our work on one atoll, has hitherto prevented us from studying this interesting complex. We hope it will be possible to do this sometime in the future.

B. Copra Production.

As the base of the economy and the only regular source of income, copra production, has profoundly influenced all aspects of the natives' lives. We have therefore judged it more appropriate and convenient to treat here in its functional context not only the purely economic activities related to copra growing, but also the interrelation and interdependence among these and other activities or aspects of the culture. We have also found it useful to include a short outline of the historical background.

1. The rise of the copra trade.

Contrary to the present situation, there existed in the Tuamotu group in pre-European times very few coconut palms, and on uninhabited atolls there were no coconut trees at all. This fact is proved not only by the numerous native traditions but also by the observations of the first European visitors to the group.*

This relative rarity of palms, which has surprised many anthropologists, is easily explained if we consider the smallness of the atoll populations and the productivity of the coconut palm. With three or four exceptions there were only some hundred inhabitants on each atoll in pre-European times, and as each palm produces at least 50 nuts a year, 20 to 30 palms amply provided for an individual's needs. Spread out over the whole atoll in accordance with the scattered habitation pattern, the few thousand palm trees required by the inhabitants, were thus easily lost among the other vegetation. This other vegetation consisted principally of pandanus palms, which gave the natives an equally if not still more important crop in the form of highly nutritive nuts.

The first traders who visited the atolls from the 1830's and onward were principally interested in sea slugs, pearls and shells, as already mentioned, but gradually they began also to encourage the natives to plant more palm trees, and many of them even brought sprouting nuts from Tahiti and had barren atolls

*For a list of these see Introduction.

planted with them. The missionaries proselytising in the group during the second half of the century accelerated further this trend and many times even directed the planting themselves. The result was that at the turn of the century on practically all atolls the pandanus and other vegetation had been replaced extensively with palm trees.

At the beginning the oil was extracted on the spot and exported in barrels, which was a somewhat wasteful and inefficient procedure. The introduction in the 1870's of the simple method of drying the meat of the nut, which then was exported undoubtedly gave the planting and the trade further impetus.

2. Change of settlement patterns.

In pre-European times the population of each atoll was fairly evenly spread out over all the inhabitable land, and each extended family had its own section of the land and lagoon. Ownership was invested in the family as a whole. The use of the products was decided by the head of the family group after more or less democratic deliberation with the other members.

An important change in residence pattern was effected during the second half of the century, when the natives were gradually converted by European missionaries, who for practical reasons persuaded the natives to group themselves together in villages. The scattered habitations had not been an obstacle for the ancient religion, as each family had its own priest, and cult places were easily constructed wherever needed. But with only one missionary priest for each atoll, who could visit it only for limited periods each year, and a single church building, the concentration of the population became a necessity.

The traders, too, preferred to have the natives gathered in one place, and that trading possibilities were deemed important by the natives is shown by the fact that many of the new villages were built near the pass or ship landing place of the atoll.

Another fact which certainly also contributed to accelerate the change in settlement pattern was the population decrease due to the ravages of newly introduced diseases. It was only natural for the surviving members in each section to seek each others' company, especially as with the advent of the new order many old hostilities and suspicions between the local groups had disappeared.

The main reason for the scattered distribution of population all over the atoll, had of course in pre-European times been economic: the food-resources were more easily and thoroughly exploited in this way. A logical consequence of the abandonment of the ancient dwelling sites and concentration into a village, was therefore the development of a new type of economy. Here the contact groups, the missionaries and traders, had handily something new to offer. The surplus copra crop provided the natives with money to buy food on the schooners and thus made them independent of the local supply of food. So interrelated was the type of habitation with the type of economy, that certainly no re-grouping of the population would have been possible, had it not been correlated with a change of the economic life.

3. Sectors and seasons.

For the purpose of making copra, the atoll is divided into several sectors (Map B), which are visited in turn simultaneously by all land owners, according to a previously agreed-upon rotation system. The main reason for this system is the scattered distribution of land holdings which makes it virtually impossible for the owner to watch his parcels from the village where he lives, and to prevent the theft of nuts. The system has an ancient taboo practice at its basis, and the same word, rahui, which formerly was used for trees periodically set aside, is now used for the sectors.

A certain sector is declared open for copra work for a well defined period by the chief after close consultation with the village council (and frequently the whole population). The owners who have land in this sector - and usually all have at least one parcel - sail over from the village and establish themselves somewhere in the sector until the work is done, whereafter they return to the village and await the opening of the next sector.

The number and boundaries of sectors vary somewhat, but at the beginning of 1950 there were three, called Raro, Village and Gake. Raro (I) comprises all the land south of the islet on which the village is situated. The village lands (II) stretch from there to the pass. The rest (III) which thus includes both Tokerau, Gake and Kereteki, forms the remaining sector, which takes the name Gake (see Map B).

The sectors are open for work 2, 3 or 4 months depending on the prospects for the harvest and the land holdings of each person. The round of all sectors is usually made in eight months, and some adjustments have therefore to be made to the annual weather seasons.

In November and December 1949, the islanders worked in Gake. According to their previous agreement, they should therefore have continued to work the sectors in the following order in 1950:

I.	Raro	4 months (January-April)
II.	Village	2 months (May-June)
III.	Gake	2 months (July-August)

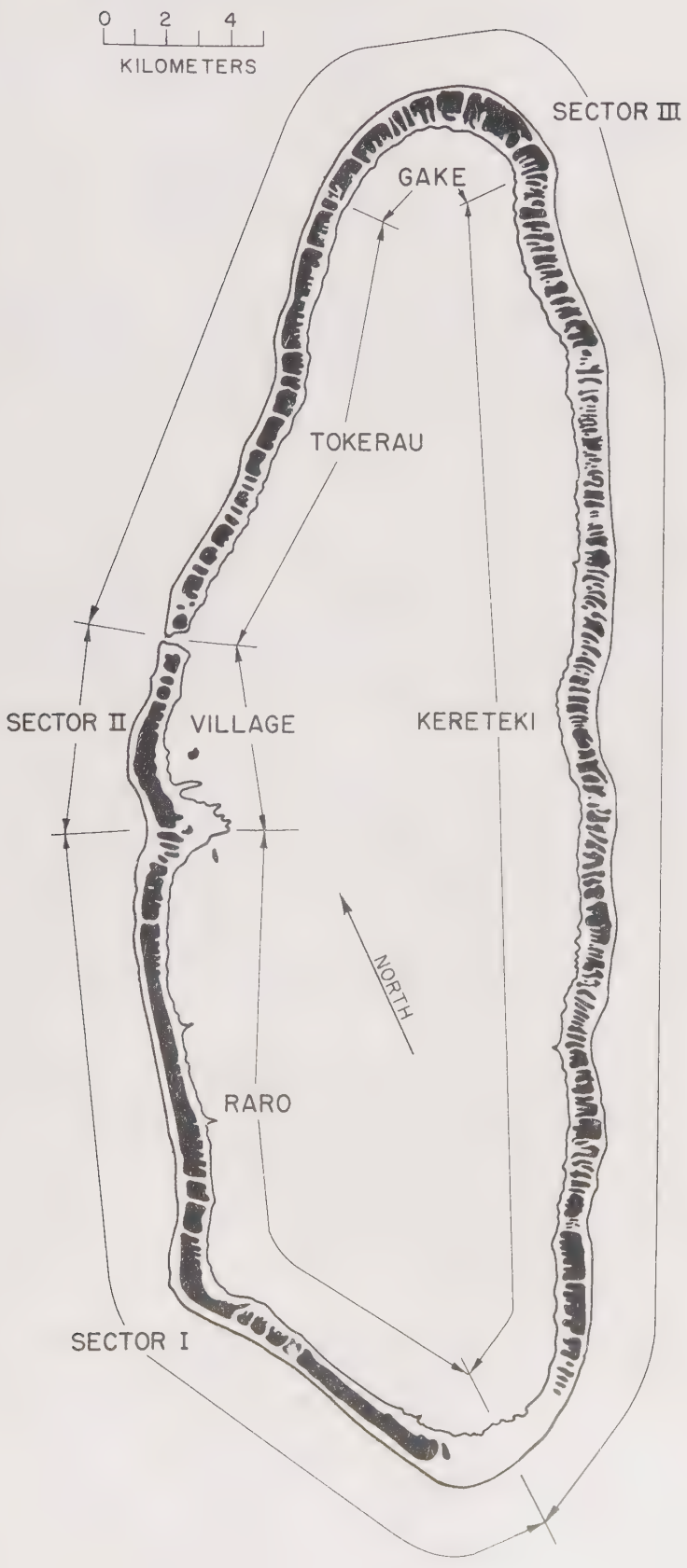
And beginning the cycle anew:

I.	Raro	4 months (September-December)

According to the schedule the islanders worked the Raro sector during the first 4 months of the year, but already by April it was decided to change the sequence and work the Gake sector before the village lands. The next change in the schedule was made in June, when the Raroians discovered that there was an unusual abundance of nuts in Raro. They decided immediately to return there in July instead of working the Gake sector. The period was eventually extended to the end of October. After the termination of the work in the Raro sector, the population decided suddenly to change the schedule completely. The atoll was now divided into only two sectors, Raro and the rest, and work was to be done 4 months at a time in each sector.

MAP B

RAROIA ATOLL



Not even these modified schedules were adhered to, and the time was actually divided between the sectors in the following way in 1950:

January	Raro
February	"
March	"
April	"
May	Gake
June	"
July	Raro
August	"
September	"
October	"
November	Village
December	"

That rigid working programs are and cannot be followed is not surprising, as they do not leave room for other activities, religious and civil celebrations, seasonal fishing, bad weather and so on. How closely the copra work actually depends on other activities and events will be shown in the next chapter.

4. Interdependence of activities.

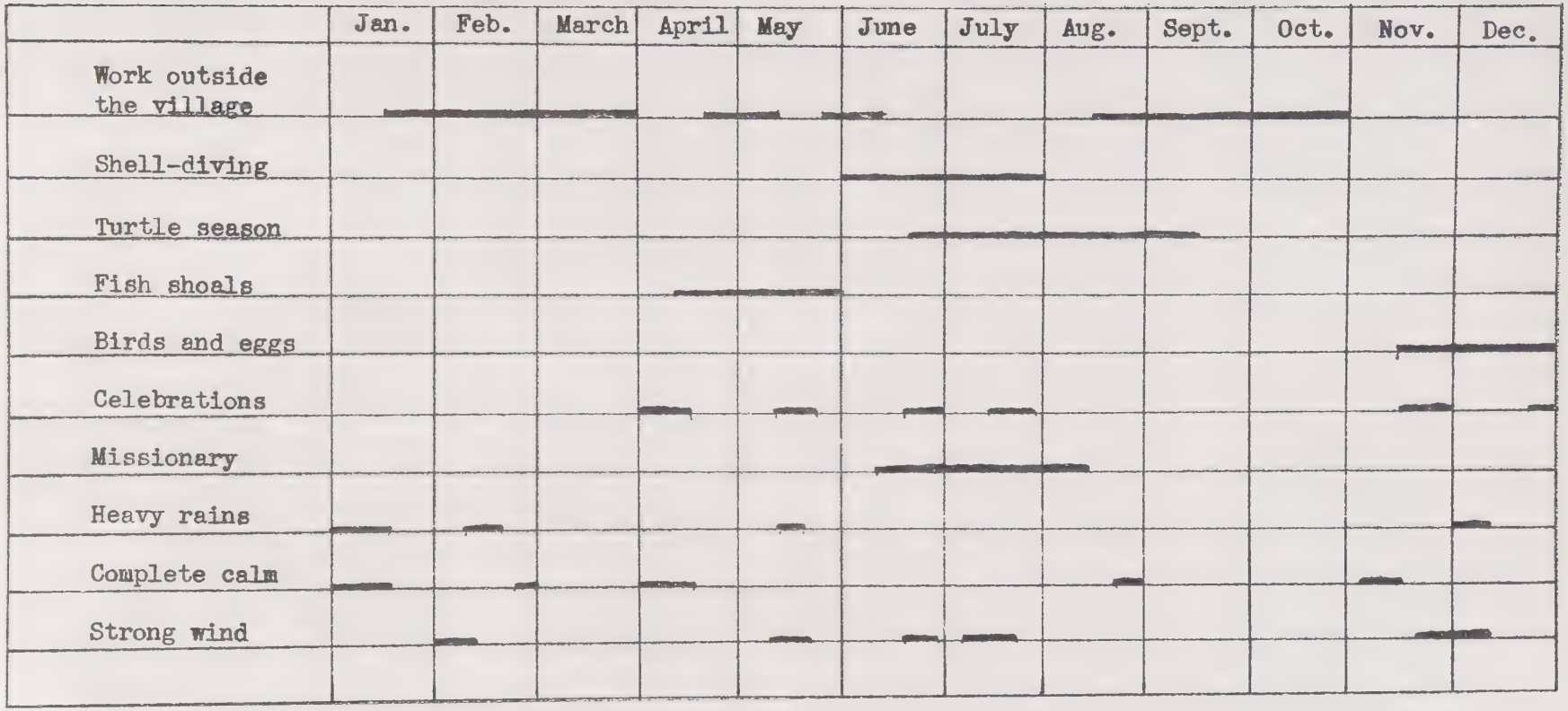
Some important interrelationships are immediately brought out by the plotting of the main activities in the accompanying chart (Table XV). In order to determine the possible influence of the weather, all periods longer than five days of heavy rains, complete calm and strong wind have been indicated. The stress here is on the interdependence of the activities, and for more detailed information on the various events during the year of 1950, Chapter III, The Annual Cycle, must be consulted.

The Raro sector was opened on January 1, but the first workers did not leave the village until the middle of January mainly because of complete calm. As there was only one motor-boat in the atoll and the majority of the natives therefore had to depend on their sailing canoes, calm or stormy weather of course completely prevented all intra-island travelling. From the middle of January to the end of March most of the islanders worked in Raro. The two spells of calm and the strong winds in February resulted principally in fewer visits back to the village, and thus more effective time spent on work.

The first gap in the work schedule occurred in April. It corresponded to the Easter week, which is elaborately celebrated in Raroia, and was prolonged a couple of days by the unique event of three schooners simultaneously loading copra. In May, only a short time after the opening of Gake, the whole population returned again to the village for Jeanne d'Arc Day (May 14th) and Ascension Day (May 18). The stay in the village was prolonged about ten days this time, as the wind was too strong and large shoals of fish appeared along the village shore.

This fish, Selar crumenophtholmus, is caught with long palm leaf sweeps, both the preparation and handling of which require a great number of men and women. The result is, however, always splendid, and many of the Raroians were

Table XV: Interdependence of activities in 1950



Note: The heavy lines indicate the activities of the main body of the islanders and the approximate duration of these activities. The exact degree of participation in copra work is shown in Chapter V, Table XVI and the relative importance of the other activities is indicated in Chapter VI. See also: Annual cycle of events, Chapter III.

so tempted by this easy way to procure delicious food, that they stayed on in the village from Easter, when the fishes first appeared, until their disappearance at the end of May. This can be seen clearly in the production records. (See part 8 of this Chapter.)

The long work interval from the beginning of June to the middle of August was partly due to the weather. June and July are the winter months with relative cold and strong winds, which frequently prevent canoe voyages. Still more important is that it is also the turtle season. The turtle is an eagerly sought food and each time a turtle is caught the whole population gathers. Two national holidays also fall in these months, the anniversary of General de Gaulle's rallying speeach on June 18, and Bastille Day on July 14. Both celebrations, which include speeches, games, and markets with wheels of fortune, were prolonged about a week.

The work stoppage - which never was complete (see Table XVI in part 6 of this Chapter) - would certainly not have been of such a long duration, if some additional reasons for staying in the village had not existed this year. The first one was the visit by the missionary, who came at the middle of June and remained on the atoll until the middle of August. Although it was certainly a coincidence that the gap in the work schedule exactly corresponded to the time of the missionary's stay, the importance attached to this visit by the islanders must not be underrated.

Diving for mother-of-pearl shell was allowed during June and July, and though the number of men who actually dived was only about a dozen, this meant at least double that number of persons absent from copra work, as the divers' families stayed in the village.

In spite of all these events and activities, the Raroians would probably have begun work in Raro, which sector was opened July 1, much earlier if an unexpected and rather unfortunate circumstance had not prevented them from doing so. Due to the capricious schedules of the schooners (see Chapter III), none appeared in time to replenish the stocks of the store-keepers, and during the first three weeks of July there was a severe food shortage. As the islanders to a great extent depend on flour, canned food, cigarettes, coffee and other imported goods when making copra, they naturally hesitated to go to work before they had been able to buy new supplies.

It is thus evident that it is a combination of factors rather than any single event which influences the working cycle. Probably still other factors than those listed above are influential in determining the decisions of the islanders and could be discovered through deeper probing, but we have to content ourselves here with these main indications and clues.

From the middle of August to the end of October there were no additional activities going on, except turtle catching until mid-September, and the uninterrupted concentration on the copra work is therefore easily explained. During all this time the sector worked was Raro.

During the final months of the year, the whole population resided in the village. A certain amount of copra was prepared on adjacent lands, but much

time was also devoted to bird catching and egg collecting in Tokerau. The weather which was very capricious, as always during this time of the year, usually determined whether the islanders prepared copra or sailed over to the northern islets on food gathering expeditions. The last week of December was of course dominated by the Christmas celebration and no work whatsoever was done.

5. Working conditions and technique.

Raroia is an atoll of considerable size with a length of 44 km and a breadth of 14.4 km. The total area is about 400 km^2 and the circumference of the reef 90 km (Chapter I). With the scattered distribution of land holdings and the concentration of the whole population in one village the islanders have to make repeated long canoe voyages in order to work the copra.

All these trips are made in sailing canoes with outriggers or in small boats, and as the wind as a rule is fairly strong and the surface of the lagoon rather rough for such small craft, the voyages to and from copra sectors are far from comfortable. The travelers are frequently drenched and suffer many times during bad weather from cold. The result is an almost continuous prevalence of coughs and bronchitis, as the Raroians have no rain cloth or warm dresses.

Under most favorable conditions, a canoe voyage from the village to the southern sector (Raro) or the northern (Gake) takes a little more than two hours. Heavy seas or contrary winds can, however, easily prolong the voyage to five or six hours. Only one person had an outboard motor and boat of European type in 1950, but it was little more seaworthy than the outrigger canoes, and could not be used at all when the sea was rough.

It must be noticed, incidentally, that for easy canoe communications, the village is not ideally situated; as it lies on the western side of the atoll, along the lagoon shore, exposed to the eternal easterly trade winds. The nearness to the pass and the good anchorage, seem, however, in the opinion of the islanders, to compensate for this disadvantage.

Only one sector, Raro, can be reached by foot from the village, and even then only with considerable difficulty as there are many intervening channels with waist-deep water. If the easterly trade winds are exceptionally strong for a prolonged period, the men may drag their canoes across the land rim and travel outside the reef along the west coast of the atoll, keeping close to the shore. Only Raro and Tokerau can be visited in this way from the village (see general map of Raroia, Section 3 of Atoll Research Bulletin No. 31).

If possible, most of the Raroians prefer to band together when working in the copra sectors. There is a total of four small villages or hamlets: two in Raro (Teputaiti and Oneroa), one in Kereteki (Tetou) and one in Gake (Tikaheru). The houses are rather primitive and invariably made of plaited palm fronds. No furniture whatsoever is used, and the family members sleep either on the earth floor or on elevated platforms. The food is cooked over open fires. No good fresh water wells exist anywhere, and the most serious inconvenience with life in the copra sector is, according to the islanders themselves, the inability over extended periods to wash in fresh water. Most

of the sectors are infested with mosquitoes, and in some places fires are necessary to keep them away. The prevalent attitude towards work in the sectors is that it is trying and uncomfortable, and always everybody expresses great satisfaction upon return to the permanent village.

The preparation of copra follows the general pattern found everywhere in the Tuamotus. The ripe nuts which fall are gathered into heaps in open clearings. They are cleft into halves by a single, well-directed blow of the axe. The halves are piled one upon the other in wall-like rows with the convex outside upwards and the hollow inside downwards. This protects the flesh against rain and provides good air circulation.

In Tahiti and other mountain islands with high humidity, drying boards which can be covered at night are required, but in Raroia where the air is comparatively dry, this is unnecessary. The simple method just described is very well suited to the local conditions with scattered land holdings and great mobility of the population, but of course it takes more time to pile the coconut halves than immediately to take out the flesh and lay it on a drying board.

When the copra meat has dried - in 4 to 8 days, depending on the weather - it is separated from the husk and put into sacks holding about 50 kgs each. The husk, together with uprooted plants and weeds, is burned. The clearing of the land may continue, but as a general rule very little time is spent in the copra sectors above the minimum required for the copra preparation.

The only implements used are a stick with a hook for gathering nuts, an axe for cleaving them and an S-formed knife for separating the meat from the husk. A long bush-knife, similar to the South American machete, is used for clearing the bush. These implements are the same as those originally introduced when the islanders first were taught copra preparation about a hundred years ago. The only technological improvement during this time which we have been able to discover is the method of drying the nut halves. Until the early 1930's the islanders suspended the nut-halves on fiber cords from the trees, as still is done for instance in the Leeward Islands. After having been persuaded by a missionary of the time gain and work economy of the method of piling the nuts in rows, they all changed over to that method.

6. Agricultural methods.

The islanders' attitude towards his plantation is very different from for instance that of an American farmer. As a rule he regards the trees as able to take care of themselves and seems never to think that the yield could be increased with better agricultural methods. This is not really surprising, as it certainly was the prevailing attitude towards the coconut tree as well as the pandanus palm in pre-European times.

The change-over to a modern surplus economy was in this case as in so many others only partial. The islanders were taught to plant trees, and did so out of profit motives, but no pertinent knowledge about new or better plantation methods ever reached them. This can be seen in innumerable instances.

To begin with, the palms are rarely planted with enough space between the trees, and there is today hardly a single plantation in Raroia planned so

as to give a maximum yield. A condition which undoubtedly has contributed greatly to over-planting is the small size of the land holdings. In order to make maximum use of his diminutive plots, each owner has planted his trees right up to the border line. The result is of course double lines of palms along nearly all borders!

The necessity of replacing old trees seems hardly to be understood either. Most of the palms are too old and the returns greatly reduced, but due to the work it requires to cut down the palms with hand axes and to the temporary loss that ensues, few owners are inclined to replant their lands.

Instead of controlled replanting, a spontaneous planting occurs all the time; as in many cases nuts which have fallen are left on the ground so long (especially when lost in the brush) that they finally grow into new palm trees. The islanders rarely want to cut down these trees under the false conviction that they mean additional nuts. 300 to 400 trees per hectare is therefore not an unusual average.

Even if the nuts are not allowed to grow into trees, they lose their value for copra making if allowed to remain on the ground too long. Ordinarily a nut begins to sprout after three or four months, after which time the flesh is unsuitable for copra. Therefore the time between the visits to a sector should not be longer than about three months. Actually the sectors are many times unworked for periods greatly exceeding this limit, as in 1950 in the case of the village lands which were revisited first after eight months, and the lands in Gake which were not visited during six months.

Very few lands are cleared, which to some extent certainly can be explained by the fact that the labor force (almost exclusively the land-owners themselves) in Raroia is not sufficient, but also probably due in part to the system of joint ownership. If a land is owned by several persons, none of course is inclined to clear and improve it; as he does not know whether he will inherit it eventually and reap the fruit of his work or not.

No fertilizers are used, and no trees are circled with rat-protecting bands of aluminum. How many nuts are eaten by the rats is of course impossible to compute with exactness. Judging from the number of pierced nuts found on the ground, the natives estimate that the rats eat between one third and one half of the crop.

The annual output is still further reduced by insects of which Aspidiotus destructor* is the worst. This insect first appeared in Raroia after the cyclone of 1906 and has since then gradually spread over the atoll. The insect attaches itself to the leaves and sucks out the sap, which seriously impedes the growth of the nuts and in extreme cases eventually kills the tree. On the seaward side, where the soil is poor, a great number of palm trees are actually unproductive. The natives are not fully aware of the menace, and the only action they have taken so far to exterminate the insects is to burn husk and refuse at the root of the palm tree, which of course is a completely inefficient measure and furthermore is harmful to the tree.

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*This insect was identified during a visit to Raroia in 1953 by Dr. W. V. D. Pieris from the South Pacific Commission. We are also indebted to him for other valuable information concerning agricultural methods.

The general outlook in Raroia is far from bright, in spite of the fact that the present annual production of coconuts is more than enough for the islanders' needs. The greatest impediment to greater agricultural efficiency is simply the ignorance of the islanders. The Raroians have taken over the idea of planting and producing a surplus, but are still unaware of the necessary requirements for such large scale enterprise. As in so many other cases, they have adopted only one element of a cultural complex, and they now suffer from the consequences of this partial lag.

7. Work participation and organization.

As we considered it of the greatest importance and interest to have complete and detailed data on the work participation and organization, we took exceptional pains to record during the whole year of 1950 exactly who participated in the copra preparation, to what extent and for how long. As we lived most of the time in the village, which is the permanent dwelling place of all the islanders and the point of departure in each case, and thus could easily keep track of the movements of every individual, the errors and omissions are at a minimum.

The work participation broken down according to sex and age is shown in Table XVI, and the percentages and averages are given in Table XVII. These tables cover the first ten months of 1950, when the Raroians worked exclusively in sectors outside of the village. For the remaining two months, November and December, the whole population lived in the village and worked the lands adjacent to it alternately with performing all sorts of minor tasks.

The continuous coming and going during these last months of the year made it of course impossible to record the number of persons working the copra each day with the same exactness as during the previous months. Therefore we abstained completely from collecting data during November and December. A fairly accurate estimate of the number of working days during these months can, however, be made on the basis of the amount of copra produced.

If we study Tables XVI and XVII closely, some general patterns are immediately discernable. The total number of persons going away to the sectors outside the village each month does not seem very impressive and rarely amounts to more than approximately half of the population. The figures may give the impression that many islanders never work, and this is of course the case with most of the children and old people, but all those of the most productive ages spend at least some months a year working in the various copra sectors. Due to the unequal distribution of the lands a Raroian may, however, work for a prolonged period in one sector and very little in another one. Hence the rotation of the working personnel every month.

The number of persons who never left the village during the whole year was 17, mostly aged people and children. The relation between family composition and work participation is shown in Table XVIII. This will be discussed further in its context.

The difference between male and female participation is not great; as seen from the figures of the percentages and the average number of working days,

Table XVI: Number of persons per month working outside the village January-October 1950.

JANUARY

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	9	6	55	24	8	94
15 - 29	14	9	127	13	9	94
30 - 44	14	8	113	11	6	95
45 - 59	9	3	18	3	0	0
60 -	4	2	22	4	0	0
Total	50	28	335	55	23	283

FEBRUARY

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	10	6	182	23	11	207
15 - 29	13	12	246	13	10	124
30 - 44	14	10	248	11	6	164
45 - 59	10	4	46	5	2	21
60 -	3	2	39	4	0	0
Total	50	34	761	56	29	516

MARCH

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	10	6	165	23	11	261
15 - 29	14	12	240	13	7	193
30 - 44	14	6	188	11	6	133
45 - 59	9	4	33	3	0	0
60 -	4	2	27	4	0	0
Total	51	30	653	54	24	587

APRIL

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	10	2	8	23	9	62
15 - 29	12	9	88	12	7	55
30 - 44	14	7	63	11	5	51
45 - 59	10	5	21	4	2	12
60 -	4	1	8	5	0	0
Total	50	24	188	55	23	180

MAY

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	9	3	40	22	11	108
15 - 29	13	11	98	13	8	76
30 - 44	14	8	81	11	6	52
45 - 59	11	4	44	5	2	15
60 -	4	0	0	5	0	0
Total	51	26	263	56	27	251

JUNE

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	9	2	18	25	7	30
15 - 29	14	12	88	13	4	35
30 - 44	15	5	40	11	5	45
45 - 59	11	5	33	5	2	18
60 -	3	0	0	5	0	0
Total	52	24	179	59	18	128

JULY

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	9	0	0	25	3	14
15 - 29	14	5	27	12	2	18
30 - 44	15	5	16	11	2	9
45 - 59	12	4	24	4	3	14
60 -	3	0	0	5	0	0
Total	53	14	67	57	10	55

AUGUST

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	9	4	24	24	11	92
15 - 29	13	13	106	12	10	96
30 - 44	15	15	119	11	6	65
45 - 59	11	7	72	6	5	54
60 -	3	1	2	3	1	7
Total	51	40	323	56	33	314

SEPTEMBER

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	10	4	77	24	11	209
15 - 29	12	11	241	11	8	168
30 - 44	14	14	273	10	6	139
45 - 59	11	9	108	5	4	89
60 -	4	1	30	3	1	28
Total	51	39	729	53	30	633

OCTOBER

AGE	MALES			FEMALES		
	Total	Working		Total	Working	
		Persons	Days		Persons	Days
0 - 14	8	3	52	21	3	13
15 - 29	10	7	73	8	4	31
30 - 44	12	11	93	9	5	72
45 - 59	11	5	51	6	3	53
60 -	4	1	2	5	0	0
Total	45	27	291	49	15	169

Table XVII: Number of persons and days spent in work outside the village in 1950.

Month	MALES					FEMALES				
	Total population	Working	Per cent working	Days of work	Ave. no. of work days	Total population	Working	Per cent working	Days of work	Ave. no. of work days
January	50	28	56.0	335	11.9	55	23	41.8	283	12.3
February	50	34	68.0	761	22.4	56	29	51.8	516	17.8
March	51	30	58.8	653	21.8	54	24	44.4	587	24.5
April	50	24	48.0	188	7.8	55	23	41.8	180	7.8
May	51	26	50.9	263	10.1	56	27	48.2	251	9.3
June	52	24	46.2	179	7.5	59	18	30.5	128	7.1
July	53	14	26.4	67	4.8	57	10	17.5	55	5.5
August	51	40	78.4	323	8.1	56	33	58.9	314	9.5
September	51	39	76.5	729	18.7	56	30	53.6	633	21.1
October	45	27	60.0	291	10.8	49	15	30.6	169	11.3
Average	50.4	28.6	56.9	378.9	12.4	55.3	23.2	41.9	311.6	12.6

which are 56.9% and 12.4 days, respectively 41.9% and 12.6 days. The high female participation is not surprising, as most women are land-owners. It must, however, be noted that their husbands usually do the copra preparation while the women take care of clearing and household duties.

As so many women participate, a natural consequence is that many of the children also spend prolonged periods in the working sectors outside the village. The number of children in the working population varies considerably from month to month as seen in Table XVI, but is on the average between 1/4 and 1/5. Older people usually stay behind in the village, and as could be expected, the bulk of the copra workers are the males and females in the most productive ages, 15-44, who account for 61.8% of the total number of working days for the period January-October. (2,568 out of 3,809 days for the males and 1,715 out of 3,116 days for the females.)

The participation or non-participation cannot, however, be explained solely on the basis of such isolated criteria as sex and age. The total family situation of each individual must be taken into consideration. In Table XVIII all persons in Raroia have been grouped according to the composition of the family. Whereas Table XVI shows how many persons participate in work, Table XVIII shows who they are as determined by family status. Those who as a rule participate in the work have been indicated by the letter w (work), and those who as a rule stay behind in the village by the letter v (village).

Only in two families out of the total number of 27 did both husband and wife regularly stay in the village all year. The exceptions are number 21 and 25. The husband in family 21 was sickly and his wife therefore stayed home in order to take care of him. The copra was made by the grown-up children. Family 25 is made up by the storekeeper and his wife, who both attend to the business. The grown-up children here also made the copra.

In the remaining 25 familes, both husband and wife went to work in 21 cases (two widows and one single man are included in this figure), only the husband in three cases and only the wife in one case. The husband staying behind in the village and letting his wife go to work alone is the chief, who considers it necessary always to be accessible in the village.

As a rule it can therefore be said, that all men who can possibly do so participate in work, which undoubtedly shows the importance of the economic motive. The women accompany their husbands in almost all cases, which is somewhat surprising as their participation in the work is negligible. A possible explanation which the islanders themselves frequently give is that the women are jealous and do not want to let their husbands go away alone to a copra sector where young girls are always present.

As the women work too, the participation or non-participation of the children depends on the existence of old relatives living in the village. Eleven of the 27 parents have small children below school-age. Seven of these parents take the children with them and the remaining four leave them in the village with an old relative. Four of the seven parents who take their children with them have old relatives in the village.

Table XVIII: Family composition and work participation.

Family composition	Participation by family member					
	Husband	Wife	Small child	School child	Grown-up child	Old relative
Single:						
Family 1	w	-	-	-	-	-
Husband, wife:						
Family 2	w	w	-	-	-	-
" 3	w	w	-	-	-	-
" 4	w	w	-	-	-	-
" 5	w	w	-	-	-	-
" 6	w	w	-	-	-	-
Husband, wife, small child:						
Family 7	w	w	w	-	-	-
Husband, wife, small child, old relative:						
Family 8	w	w	w	-	-	v
Husband, wife, small child, school age, old relative:						
Family 9	w	w	w	v	-	v
" 10	w	-	v	v	-	v
" 11	w	v	v	v	-	w
Husband, wife, small child, school age, grown-up child:						
Family 12	w	-	w	w	w	-
Husband, wife, small child, school age, grown-up child, old relative:						
Family 13	v	w	v	v	w	v
" 14	w	w	w	v	w	v

Family composition	Husband	Wife	Small child	School child	Grown-up child	Old relative
Husband, wife, small child, grown-up child						
Family 15	w	v	v	–	v	–
" 16	w	w	w	–	w	–
" 17	w	w	w	–	w	–
Husband, wife, school age child:						
Family 18	w	w	–	w	–	–
" 19	w	w	–	w	–	–
Husband, wife, school age child, old relative:						
Family 20	w	v	–	v	–	v
Husband, wife, school age child, grown-up child:						
Family 21	v	v	–	v	w	–
" 22	w	w	–	w	w	–
" 23	w	w	–	w	w	–
" 24	w	w	–	w	w	–
Husband, wife, grown-up child:						
Family 25	v	v	–	–	w	–
" 26	w	w	–	–	w	–
Husband, wife, grown-up child, old relative:						
Family 27	w	w	–	v	–	v

Out of the 15 parents with children of school-age (6-14 years), nine leave their children in the village. Seven of these nine parents have an old relative in the village who takes care of the children, whereas in the remaining two cases one or both parents stay in the village. The remaining six parents usually take their children of school age with them to the copra sectors. Significantly none of these parents has an old relative in the village.

The grown-up children work regularly in nine cases out of ten.

The dependence on older relatives for the care of the young children is thus amply proved by the figures. In the case of the children below school-age there is no problem, as they can travel with the parents, if no old relatives exist. The children of school-age create, however, a conflict when there is no old relative living in the village. All parents affirm that they want their children to go to school and seem to have a firm belief in the advantages of acquiring a European education. Yet, in spite of this, each time when this desire conflicts with the work, the latter is given precedence, as seen in the six cases enumerated.

A simple solution would of course be to leave the wife behind in the village with the children. Another would be to better co-ordinate the annual working cycle with the school terms. As the women seem to have a strong inclination - due to jealousy or whatever it may be - to accompany their husbands to the work outside the village, the second solution would certainly be the most acceptable. No attempt has yet been made, however, to achieve such a co-ordination, which shows once more how erratic the islanders' efforts are to adjust themselves to new situations and how unsatisfactory the integration of the various cultural elements is.

8. Weekly variations.

The predominance of economical considerations in the case of the conflict between work and school duty of the children was evident (see previous section). It may therefore be of interest to examine also the relationship between economic and religious activities.

From the very beginning of our stay we noticed a marked tendency among the islanders to return every Sunday to the permanent village, where the only church on the atoll is situated. That this is a regular habit is confirmed by our data for the whole year, but in order to avoid unnecessary repetitions, we have limited our analysis here to a sample month, September.

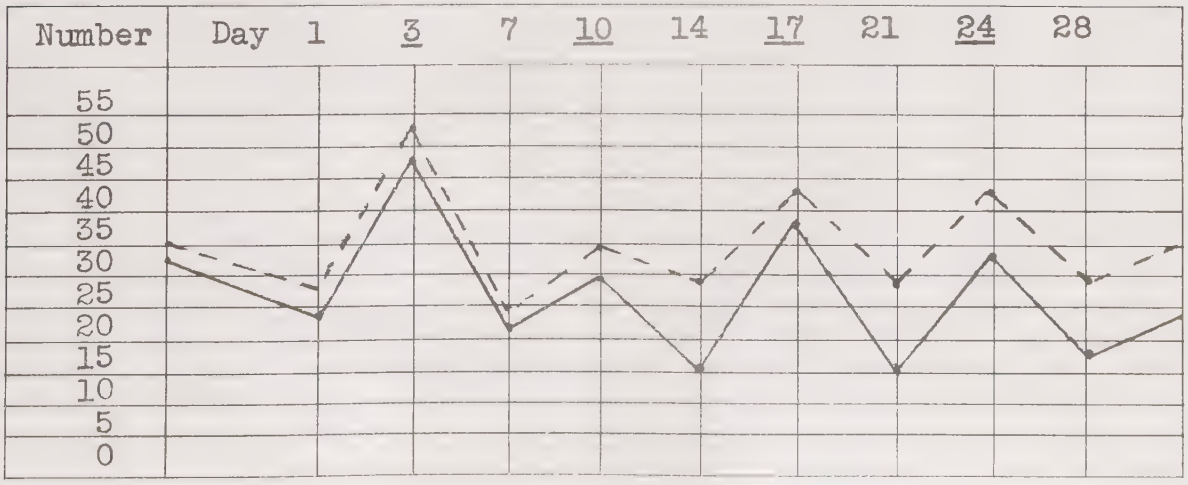
In Table XIX are shown the number of persons in the village on Sundays (September 3, 10, 17 and 24) and Thursdays (September 7, 14, 21 and 28). In addition, two other tables have been prepared, one showing the variations according to sex and another according to age classes. This differential treatment of the data brings out some unsuspected facts.

The extent to which the islanders return to the village on Sundays - even if it requires a long canoe trip and the loss of at least one working day - is surprisingly great, as shown by the differences between the village population on weekdays and Sundays, which are respectively: ≠ 44, - 50, ≠ 17, - 19, ≠ 35, - 36, ≠ 30, - 26! The high figures are, however, less surprising if we take into consideration that Sunday in any event is sacred, and that no islander works this day, even if he is alone on an isolated islet far from the village.

Table XIXa: Number of persons in village on weekdays and Sundays in September 1950.

Sex	Age	Total	Number of persons in village on 1	3	7	10	14	17	21	24	28
MALES	0 - 14	10	6	9	7	6	5	7	4	6	4
	15 - 29	12	2	12	3	8	3	11	2	10	3
	30 - 44	14	4	13	4	8	2	11	3	10	3
	45 - 59	11	8	11	6	5	3	6	4	5	6
	60 -	4	3	2	2	2	2	2	2	2	2
	Total	51	23	47	22	29	15	37	15	33	18
FEMALES	0 - 14	24	15	22	13	15	14	18	13	14	14
	15 - 29	11	3	11	2	7	5	9	4	11	3
	30 - 44	10	4	10	4	6	5	8	6	7	5
	45 - 59	5	4	4	3	4	3	5	3	5	5
	60 -	3	3	2	2	2	2	2	2	3	2
	Total	53	29	49	24	34	29	42	28	40	29
Males & females		104	52	96	46	63	44	79	43	73	47

Table XIXb: The same data presented in graphical form.



_ _ _ _ _ _ _ _ women
_____ men

That there are no significant differences between the sexes can clearly be seen in Table XIXb (the graph).

On the basis of the data presented hitherto, it seems natural to conclude that the islanders return solely for the purpose of attending the church service. If we, however, take the age factor into consideration, as done in the following table, we shall find that there evidently is an additional motive present.

Table XX: Average number of persons in village weekdays and Sundays during September 1950.

Sex	Age	Total	Weekdays	Per cent	Sundays	Per cent
MALES	0 - 14	10	5.2	52.0	7.0	70.0
	15 - 29	12	2.6	21.6	10.2	85.0
	30 - 44	14	3.2	22.8	10.5	75.0
	45 - 59	11	5.4	49.0	6.7	60.9
	60 -	4	2.2	55.0	2.0	50.0
FEMALES	0 - 14	24	13.8	57.5	17.2	71.6
	15 - 29	11	3.4	30.9	9.7	88.1
	30 - 44	10	4.8	48.0	7.7	77.0
	45 - 59	5	3.6	72.0	4.5	90.0
	60 -	3	2.2	73.3	2.2	73.3

This table gives the average number of males and females present in the village on Thursdays and Sundays, arranged according to age. The percentage shown is the per cent of persons present on Thursdays and Sundays as compared to the total number of individuals in each age class. The significant factor is thus the increase of the percentages on Sundays.

One is immediately struck by the fact that this increase is considerably less for the youngest and oldest age groups than for individuals of the most active ages. In age group 0 - 14 the increase is only from 52.0% to 70.0% for the males and from 57.5% to 71.6% for the females. For the age groups above 45 it is still less, and in one case, males above 60, even replaced by a decrease. On the other hand, for the age groups 15 - 29 and 30 - 44 there is a big jump from the percentage figures for weekdays to these for Sundays, doubling or tripling them.

If the motive to return to the village were exclusively religious, it should be expected to operate with equal force for all age groups, but this is clearly not the case. The only possible explanation is therefore, that the social and recreational motives are as important as the religious one. These motives are of course more dominant in the ages 15 - 44, and most men and women of these ages return evidently to the village seeking diversion, whereas the older people stay behind with the children in the working sector.

During the great church holidays, religious considerations are, however, paramount, as all the workers irrespective of age return to the village.

This tendency to return regularly on Sundays to the village, reduces of course greatly the time actually spent on copra work, as the sectors are situated at a great distance and bad weather frequently prolongs the canoe trips. The influence of this habit on the annual output of copra must not be overlooked.

9. Actual and potential production.

According to the chief, the total copra production in 1948 was 221 tons and in 1949 as much as 253 tons. How reliable these figures are is difficult to say, but for 1950 we kept record of all copra produced, and the total amount was 187 tons. If the figures for the preceeding years are correct, the average output per year should be around 200 tons.

For producing about 200 tons of copra a year on the soil found at Raroia, 200 hectares should suffice. The total area planted with coconut palms is according to our estimate, based on a study of the aerial map, 587 hectares (see Chapter I). Almost three times as much copra could therefore be produced on the atoll, if our figures are correct. The great discrepancy between the actual and potential output must be due to such factors as dense planting, old trees, abundant underbrush, ravages by rats, insect pests, lack of fertilizers, picking of drinking nuts, and so on. Some of these aspects have been discussed in previous chapters, but the problem as a whole must of course be left to a specialist.

The tonnages of copra produced each month of 1950 were as follows: January - 7.5, February - 30, March - 24, April - 11, May - 12.5, June - 10, July - 2, August - 14, September - 40, October - 14, November - 8, December - 14. The variations are of course due to the amount of time the islanders devoted to other activities and will be clearly understood only by a comparison with the facts presented in part 4 of this chapter dealing with the interdependence of activities.

Divided between the various sectors (see map accompanying part 3) the copra production for 1950 was as follows:

I	Raro (January-April, July-October)	142.5 tons
II	Village (November-December)	22.0 tons
III	Rest of the atoll (May-June)	22.5 tons

Of the total output in 1950, 76.2% of the copra came from Raro, 11.8% from lands around the village and 12.0% from the rest of the atoll. The relative size of the planted area in the three sectors is approximately, in the same order, as 7 to 2 to 3, or expressed in percentages:

Raro	58 1/3%
Village	16 2/3%
Rest	25 %

This comparison between the relative percentages of the output and of planted area shows some marked differences. For the village lands the output

is only slightly below what could be expected judging from the size of the planted area, and the figures are almost identical if we do not count the village itself, where few palm trees are planted. A disproportion between the production and the area in the two other sectors exists, however, undoubtedly, and the figures confirm only our subjective impressions during the year.

The discrepancy of the figures, seems to indicate that the third sector (comprising all the land on the eastern, northern and northwestern side of the atoll) is not worked to full capacity. This neglect is easily explained by the fact that it is more lonely and time-consuming to make copra on the numerous small islets in this sector than on the contiguous lands in the two remaining sectors.

A comparison between the size of the planted area in each sector and the time during which the sectors were open is also illuminating. The sectors were open respectively 8, 2 and 2 months, which expressed in percentages and compared to the proportional size of each sector give us the following table:

Sector	Area	Time
Raro	58 1/3%	66 2/3%
Village	16 2/3%	16 2/3%
Rest	25 %	16 2/3%

The length of time during which each sector is open is thus not completely proportional to the size of it. These periods do, however, correspond to the total time actually spent in each sector, which is determined by various other activities and considerations (see part 4).

10. Working efficiency.

In this chapter we shall finally try to ascertain the working efficiency, or the average time needed for producing one ton of copra, in order to see whether the relatively low annual output can be explained in these terms. The figures presented here are based on the complete records of work participation in part 6 of this chapter (Table XVI).

Before we can proceed to a computation of the average working time and output, some adjustments have to be made. In the first place it should be noted that the time spent in sectors outside the village is counted from the departure to the return. As distances are great and some preparation necessary each time, usually no work is done on travel days. Another factor which frequently reduces the time spent in effective work is bad weather or calms. These often prevent the islanders from fulfilling their work schedules. Finally, as a rule each worker spends some days fishing or gathering other foods. All this reduces considerably the time actually devoted to copra production, and if we estimate the effective working time as 2/3 of the total time, our figure is certainly not too high.

Table XXI: Number of working days of the productive males compared to amount of copra produced in 1950.*

Month	Working days		Tons of copra
	15-44	45-59	
January	240	18	7.5
February	494	46	30.0
March	428	33	24.0
April	151	21	11.0
May	179	44	12.5
June	128	33	10.0
July	43	24	2.0
August	225	72	14.0
September	514	108	40.0
October	166	51	14.0
Total	2,568	450	165.0

The contributions of the different age-classes varies. The children below 14 years of age may help a great deal at the camp with food-preparation and also often go fishing, but their contribution to copra production must otherwise be disregarded. The same is true for the few individuals above 60, who occasionally accompany the working parties. As to the age-group 45-59, its output is doubtless much less than that of the younger men, and we have therefore estimated their efficiency as 50% of the latter group.

The females accompany their husbands as a rule, but their contribution to the copra work is very slight, and even the women who are land owners themselves, usually let their husbands or a male helper do the collecting and cutting. This does not mean, however, that the women are without occupation. They tend the children, take care of the household duties, clear lands and assist their husbands in minor ways. This limited role of the women is of course impossible to confirm statistically. The population was always spread out and we lived in the main village most of the time, but repeated visits to the different sectors all round the year, led us to believe it to be the general pattern. In the following estimate of the working tempo, we have therefore preferred to disregard completely the female participation.

The total number of working days for the males during January-October (according to Table XVI) was 2,568 for age class 15-44, and 588 for the age class above 44. If we first reduce these figures by 1/3 for lost time, and then discount 50% for the latter class for lost efficiency, we get the follow-

*The figures are for the first ten months of the year during which the sectors outside of the village were worked. For the remaining two months, when the lands around the village were worked, only the amount of copra produced was recorded. These figures were 8 tons in November and 14 in December.

ing figures:

15-44 years old	2,568	working days
Less 1/3	856	" "
	1,712	" "
45-59 years old	450	" "
Less 1/3	150	" "
	300	" "
Less 1/2	150	" "
	150	" "

1,712 plus 150 = 1,862 effective working days, during which 165 tons of copra were produced, making an average of 11.3 days per ton, which seems reasonable. In Tahiti a good worker prepares one ton a week, but working conditions are very different there, as no time-consuming piling of the nuts is necessary, the undergrowth is kept at a minimum, the plantations are much bigger and the existence of covered platforms makes the work more independent of the weather.

If only men between 15-44 are counted, the average output per individual for 1950 is 7.79 tons. There is thus a wide gap between each individual's actual and potential output, a gap which must be accounted for by the various factors discussed in previous sections.

Chapter VI

SUBSISTENCE ACTIVITIES

With the year-round work on the plantations and the good earnings from copra and mother-of-pearl shell sales, the islanders neither have time nor find it necessary to carry on any extensive planting or food-gathering, as they did in pre-European times. The taro fields were abandoned after the cyclone in 1903 and nobody has planted any since then. Some lime and papaya trees have been introduced, but no efforts are spent on their cultivation, and the number of trees is insignificant. The pandanus palm grows wild all over the island, but is not used for food any more.

Few domesticated animals are kept, and these consist almost exclusively of hens, pigs and dogs, which as in ancient times are still eaten. Fishing is practiced to a considerable extent, especially during the working periods away from the village, but shell fish, of which there never has been any abundance in Raroia, are rarely gathered. Turtles are caught and sea birds and eggs collected but these are strictly seasonal activities and more practiced as a sport than as regular food-gathering activities.

Instead of these traditional foods the islanders buy now imported provisions like canned beef, flour, rice and biscuits, which make up a diet much inferior to the ancient one. The main aim is, however, achieved from the islanders' point of view: no working time is lost on prolonged food-gathering and tedious preparations and all efforts can be concentrated on the production of a surplus, the income from which permits the acquisition of all sorts of luxury articles.

1. Plant cultivation.

The poor soil is a serious obstacle to the growing of varied and abundant crops, and the number of plants found on the atoll is actually very limited. The situation is hardly improved by the fact that practically no efforts are devoted to the care of the plants, and the word "cultivation" is therefore definitely an euphemism!

Of food plants which existed on the atoll in pre-European times the coconut palm is still the most important, but strangely enough no distinction is made between palm trees intended for production of copra and food trees, in spite of the fact that certain varieties are much sought after because of the special qualities of the nuts. What has been said about the coconut palm in the previous chapter on copra production applies therefore equally well here.

One of the islanders tries to grow bananas in a ditch filled with refuse but this must be regarded chiefly as a luxury hobby, as the yield is not more than five or six bunches a year. There are 73 breadfruit trees altogether, but only 23 bear any fruit. The total number of fruits on these trees each season does not exceed 300, and therefore their role in the diet is insignificant.

The only introduced plant cultivated to any extent is the papaya, of which there are 87 trees of which one third are fruit-bearing. Most of these have been planted by the Chinese storekeeper, who gives away the fruits as goodwill service. In spite of the fact that the papayas, like the breadfruit, are highly appreciated by the islanders, very few of them have planted any, and only half of the 27 families have trees of their own. Vegetables are not grown as the soil is unsuitable.

This lack of interest in plant growing is probably a result of the islanders' ignorance of modern agricultural methods and of the relative nutritive value of the various kinds of food. Nobody suspects for instance that the fruits contain vitamins which are not found in the imported food, and these additional food resources are therefore over-looked. That the islanders do not take better care of the few existing food-trees is certainly also due to the lack of adequate knowledge of how to increase the yield.

2. Animal husbandry.

The number of pigs, hens, ducks and dogs per family is as follows:

Family*	Pigs	Hens	Ducks	Dogs
1	-	-	-	2
2	1	5	-	2
3	-	-	-	1
4	-	-	2	1
5	-	-	-	-
6	-	-	1	1
7	-	3	-	3
8	1	4	-	2
9	2	-	3	1
10	1	-	-	2
11	-	3	3	2
12	-	-	-	1
13	2	6	2	2
14	2	2	-	-
15	-	7	2	2
16	-	-	4	2
17	-	6	-	1
18	-	12	4	4
19	-	-	-	-
20	1	-	-	-
21	1	10	7	3
22	-	3	2	4
23	-	-	-	2
24	-	-	-	1
25	-	9	7	2
26	-	-	-	1
27	1	6	4	2
Total	12	76	41	44

*For composition, see Table XVIII in part 6, Chapter V.

The total number of domesticated animals is not impressive, and the islanders often say that they should like to keep more, if they only were able to feed them. But this is difficult for the Raroians for two reasons: there is little food for animals besides nut kernels, which are too valuable, and the nomadic character of the islanders' existence does not go very well with animal husbandry.

This applies especially to pigs, which explains their comparatively small number. Significantly enough, pigs are also kept only by families who always leave a member, usually an old relative who takes care of the school children, behind in the village during the working periods in the sectors. But even some of these families hesitate to have a pig due to the fact that it has to be fed with coconuts.

Contrary to the pigs, which because of the feeding, are always kept in enclosures of palm logs, the hens and ducks roam about in complete freedom, as they are supposed to be able to take care of themselves. A greater number of families can therefore keep hens and ducks without interference with the work. The number is nevertheless very limited, which certainly is due to the fact that the hens and ducks under these conditions are of little value. The eggs are never found, or they are eaten by rats, and the hens and ducks so meager that they hardly are palatable.

The dogs alone of all the domesticated animals can accompany the islanders on their trips to other parts of the atoll, which certainly is the main reason for their continued popul rity. The dogs seem primarily appreciated for their food value and only in a very secondary way for their companionship. As no dogs are regularly fed, only young dogs are tender enough to be eaten. Many dogs are, however, saved for reproductive reasons, and most of the 44 dogs found at the time of our survey were of a fairly advanced age, many of them actually too old, which is not so surprising as the Raroians never kill a dog except when they intend to eat him. There is a tax imposed in order to keep down the number of dogs, but as it is extremely small it does not have the desired effect.

3. Fishing.*

There is an abundance of fish of all kinds in Raroia both in the lagoon, the pass and the surrounding sea, as well as on the outer reef flats. Some species are seasonal, appearing in most cases from October to December, but throughout the year there is always more than enough fish for the islanders' needs.

Species

The ichthyologist of the 1952 coral atoll research team caught about 400 different species in only two months time (Harry, 1953, page 44). Of these around 150 are food fishes of a size big enough to be worth while catching for the islanders. The most common food fishes are: parrot fishes, goat fishes, trigger fishes, wrasses, jacks and tunas.

*A more detailed and technical paper will be published elsewhere.

Some ocean species like dolphin, swordfish and flying fish, which were frequently taken in ancient times, are not fished for any more because the present-day inferior canoes do not permit extended sea voyages. Most of the edible species in the lagoon, the pass and on the outer reef are, however, still caught; though dependence on fishing has greatly decreased since the rise of the copra trade and the introduction of foreign foods.

Fishing methods

Except for the inevitable replacement of old material like mother-of-pearl shell and bone by iron, the fishing methods have generally preserved their Polynesian character. As a matter of fact no other elements of the old culture, either spiritual or material, have survived so well. As the present study deals primarily with present conditions no effort has been made here to reconstruct the fishing methods, which have been lost, but only those still in use will be described.

The general term for fishing is tautai, but as for so many other highly specialized activities the natives have also in this case numerous specific names. We have indicated the terms, where necessary, in the descriptions under four main categories: hook and line fishing, spear fishing, net fishing and miscellaneous methods.

a. Hook and line fishing.

This is a very popular method used exclusively or principally for catching the following kinds of fish: tunas, snappers, jacks, trigger fish, sea bass, and wrasses. Here, as in the rest of Polynesia, the islanders practically never use floats and rarely rods. A special sinker is usually deemed unnecessary, and when fishing at great depths the hook is simply lowered with the help of a coral stone tied to the line with a slip knot. As soon as the hook reaches the desired depth, the stone is released by giving the line a sharp jerk.

The hooks in pre-European time were made of shell or bone and were of the circular, barbless, Polynesian type, which is ideally suited for the marine environment as it does not get entangled in branching corals. Unfortunately in the Tuamotus they are now everywhere replaced by European iron hooks of the ordinary J-shape, which are far inferior. The excellent commercially made iron hooks of Polynesian model used in Hawaii and previously unknown in French Oceania were introduced in Raroia by us in 1952.

The general word for hook and line fishing is kanehu, but specific names exist for every variety of it. A very common method in ancient times, called topepu, was to swim slowly about in the lagoon or open sea, supported by a log while holding the line in one hand. In most cases, today the islanders fish from an anchored canoe. Trolling with mother-of-pearl shell hooks, tavere, is practiced for catching tuna. Rods are used to a limited extent for fishing from the edge of the outer reef, a method called tiutiu.

b. Spear fishing.

This method is used almost as much as hook and line fishing but mostly for other species of fish, such as parrot fish, goat fish, porcupine fish, butterfly fish, surgeon and unicorn fish. The spears are usually made of mikimiki (Pemphis acidula) wood fitted with an iron point. This point is usually made by the islanders themselves out of scrap-iron over a primitive forge. The spears have either a single barbless tip or four barbed prongs. The single, barbless spears are of two sizes, one 4-5 feet and the other around 10 feet long, whereas the four pronged spears are all 10-12 feet long.

Of the barbless spears, the short ones are used for poking under stones in shallow water, the long ones for under water fishing during which the fisherman dives down and transfixes his quarry. The barbed, four pronged spears are thrown from a standing position on the shore or the edge of the reef. The spear is held by the right hand at the extreme end with the index finger on the butt and supported at the middle by the left hand. The spear is cast with an overhand throw and the precision is amasingly good.

The word patia is used both for the spear and the method in general. The names for the varieties are: pakeke, poking out the fish from holes with the short, barbless spear and transfixing them; tupoa, underwater spearing with the help of tridacna shells which attract the fish; and fautau, throwing the four pronged spear.

c. Net-fishing.

Net-fishing is very little practiced, even less so than in pre-European times, in spite of the fact that ready-made nets and lines can now be bought in Papeete or aboard the schooners. The reasons for this decline are probably the improvement of other types of fishing gear like hooks and spears by the introduction of iron, and the cumbersome character of a net. A man can always take a spear and a couple of hooks with him during his trips to the copra plantation, and invariably does so, whereas a net is heavy and usually cannot be handled by one man alone. Another fact, which certainly limited the use of nets even in pre-European times, is of course simply the unfavorable environment. Nets are easily entangled in sharp and branching corals and sharks destroy both fish in nets and net alike.

The only nets in common use today are small seines attached between poles and handled by two men who encircle the fish with the net. The net is called kope, and used principally in shallow water along the lagoon shore or in the channels between the islets. Fishes caught in this way are goat fish, parrot fish and mullet.

d. Miscellaneous methods.

The only other methods worth mentioning are:

Fakakopa. The fish, usually parrot fish, are chased when they appear in the shallow water on the outer reef until beached or enclosed in an embayment. They are then speared or taken by hand.

Rena. This is the garland fishing with palm leaves called hukilau in Hawaii. The garland may be up to 200 yards long and is made of palm leaves cut in halves length wise, twisted and joined together. The garland is handled by a great number of people and this is actually the only community fishing undertaken today. Seasonal fishes like Selar crumenophtholmnus and small parrot fish are caught in this way.

Rama. Night fishing on the outer reef flat. The fish is blinded by light, usually from a Coleman kerosene lantern, and stunned by a blow over the back with a long bush knife. Fish caught are principally squirrel fish and certain wrasses.

Relative importance of fishing activities.

Since pre-European days, when probably every adult spent several hours a day fishing or gathering shells and clams, the time devoted to these activities has gradually decreased with the emergence of a money-economy.

In order to get some measure of the relative importance of fishing to the present-day economy we recorded the number of persons going out on fishing trips during a sample week, December 4-10, 1950, when the whole population was in the village. Another similar sample taken in a more summary way in June the same year under identical conditions, gave approximately the same results, and it seems reasonable therefore to regard the following sample week as fairly typical for the fishing activities of the islanders during their stays in the village. Two and three hours are spent fishing each time on the average.

Table XXII: Number of persons fishing, Dec. 4-10, 1950.

Age	Total in village		Mon.		Tue.		Wed.		Thu.		Fri.		Sat.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
0-14	9	21	4	0	6	2	5	0	6	1	3	2	9	6
15-59	35	27	9	4	7	3	11	3	6	0	10	3	21	7
60-	3	2	1	0	0	1	0	0	0	1	0	0	1	1
Total	47	50	14	4	13	6	16	3	12	2	13	5	31	14

The number of persons fishing each day is strikingly low, especially if we discount the boys below 14, who many times roam about or play instead of making serious efforts. The increase of the number of fishermen on Saturday is in accordance with the Raroians' general working cycle. No work whatever is done on Sundays, which is a real holiday with absolute rest and copious meals. The preceeding day is therefore devoted to food gathering and preparations of all kinds.

Another thing clearly shown in the table is the insignificant participation of the females. The explanation for this is simple. In ancient times there was a sharp division of labor according to sex in this case as in so many others, and the males did the actual fishing with hook and line, spear or

net, while the females only gathered shells, clams, crustacea and similar sea foods. The islanders still cling to this labor division, but the supply is not the same as in old times due to the new habitation pattern.

There is still plenty of fish around the village, but the supply of other sea foods is exhausted and insignificant compared to the great number of persons living on this limited part of the atoll. With the scattered dwellings in pre-European days, each family had long stretches of reef at its disposal, but this is no longer the case. Therefore the women cannot continue their traditional activities, and as they consider it unthinkable to take over the males' activities, there is not much use for them to go out collecting.

If this is true, the women should devote more time to the collecting of sea food, when they are away from the village working in the various copra sectors. We have not been able to gather any quantitative data on this, but if we are to judge from our own subjective impressions during repeated visits and stays in the copra sectors, this seems actually to be the case. Even the men seem to fish more frequently when they work in the copra sectors, and we have gained the definite impression that almost all of them spend an hour or so a day fishing. This is only logical as the supply is more abundant in the less-frequented waters far away from the village, and as the amount of other food which can be brought in the canoes always is limited.

4. Turtle catching.

The season lasts from June to September during which months a small number of turtles appear in the sea immediately west of Raroia fairly close to the shore. At the beginning of the season both male and female turtle are caught when they breed in the water. At the end of the season, however, most of the turtles caught are females overtaken when they crawl up on the sand beaches to lay their eggs.

The islanders show a great appreciation for turtles as food. This is understandable as turtles constitute the only first class fresh meat obtainable in the atoll. In ancient times the turtle was an animal eaten only after appropriate religious ceremonies. The meat was reserved for men. In Raroia the women are now allowed their share of the turtle meat, but it was only about 20 years ago that this old taboo was broken.

The tastefulness and rareness of such a delicacy as turtle meat explains why the whole population is on the lookout during the season and why everybody abandons all other occupations when a turtle is sighted. Only one method is generally used today for catching turtles. The hunter, equipped with a long rope, to the end of which a huge iron hook is attached, paddles together with assistants to the spot where a turtle has been seen. He dives into the sea when the turtle appears and tries to place a hook in its throat, the only vulnerable spot of the animal. If he succeeds, his companions in the canoe who have held fast to the other end of the rope all the time, slowly haul up the turtle. It is overturned and towed ashore.

The turtles usually weigh about 200 pounds. One is enough for a real meal for the whole population. The turtle is cut up, cooked in an earth oven

(the only occasion when it is still in use), and the meat divided up among all the persons present. In 1950 the total number of turtles caught was 17, and the average number per season seems to have been between 15 and 20 both the preceeding and following years.

The successful turtle hunts are matched by an approximately equal number of unsuccessful ones, which means that between 30 and 40 days a year are devoted to this activity. About a dozen men are engaged in the hunt and food preparation each time. The number of lookouts and assistants is of course much higher. The turtle catching therefore limits to a certain extent the time which can be devoted to other occupations during these months.

5. Egg collecting and bird catching.

These are also strictly seasonal activities taking place during the last months of the year, October - December. Two species of noddies, the brown, goio (Anous stolidus) and the white-capped, kikiriri, (Anous minutus), nest during these months in amazingly great numbers on the northern part (Tokerau and Gake) of the atoll. As the noddies lay their eggs in nests on the ground or in the branches and hollows of bushes and low trees, they can be collected without any difficulty. The birds caught are young noddies which simply are taken by hand.

Small groups of young people sail during this season once or twice a week over to the northern part of the atoll and spend a day at a time there. Each person brings back at least four or five dozen eggs and half a dozen young birds from such a trip. The eggs are all eaten irrespective of the stage of development of the embryo. Some of the birds may be kept in captivity and fed for some time before being killed, but most of them are eaten immediately.

There are altogether 20 species of birds, either resident or migratory* in the atoll and many are highly prized as food, but the islanders rarely capture them. Most of these birds were commonly trapped in various ingenious ways in pre-European times.

*See list by Danielsson-Natua published in a subsequent section of this Atoll Research Bulletin No. 32.

Chapter VII

LABOR DIVISION AND SPECIALIZATION

1. Division according to sex.

The division of labor according to sex, prevalent in pre-European days, is still adhered to, and new activities are divided in a similar manner within this general framework. In the following table we have included not only the activities within the framework of the surplus and subsistence economy dealt with in preceeding chapters, but also most of the other common occupations of the islanders.

Division of work

Work of men	Work of women	Joint work
Copra cutting Clearing of lands Separating the copra from the husk	Piling the nuts	
Fishing with line and hook, spear and net Turtle catching	Gathering shells and crustaceae	Torch fishing Egg collecting and bird catching
Canoe building House building	Plaiting of palm leaves	
Cooking in earth oven	Other cooking and household duties	Water carrying
		Training and care of children
Political offices Religious offices		

2. Co-operation.

Work, which in pre-European times was characterized by a high degree of co-operation, has now become almost wholly individual as a result of the introduction of a competitive money economy and the breakdown of the old social system with hierarchial authority. When, for instance, today a man wants to build a house or needs help for other big enterprises, he has to pay the workers, and the wages are almost as high as in Tahiti, i.e. 100 francs a man per day.

The only instances of extensive co-operation among the islanders during our various stays in Raroia were the garland fishing, the turtle catching, the launching of a boat and repair work on the quay.

The garland fishing requires the co-operation of at least half the population if it is to give good results, and usually all persons present in the village participate in the catch when a fish shoal appears. The fishes caught are divided evenly among all the participants irrespective of age, sex or role during the fishing.

To catch a turtle requires a considerably smaller number of persons, but as a rule at least three or four work together. The whole population helps, however, to prepare the meal and partakes of it. Those who have not participated in the catch pay the captors for their share of meat. The price of a turtle varies between 1,000 and 2,000 francs, according to size. This is the price demanded aboard the schooners when living turtles brought from Puka-puka or other atolls are sold.

The boat-launching we witnessed was undertaken by practically the whole population, who pushed and pulled a newly constructed cutter from the work shed down to the beach 300 yards away. The old work-songs, which otherwise are never heard, were sung, probably to a large extent because the islanders knew that we were interested in ancient customs. The owner of the boat distributed after the launching two cases of corned beef (48 cans) and one sack of flour (50 kg) to the population, and the day ended with a community feast.

The repair work on the quay lasted about a week. It was not a voluntary co-operation like the previous one but actually an imposed chore, organized by the chief on orders from his superiors.

3. Specialization.

The emergence and degree of specialization in Raroia depends evidently on the transformation from the old to the new type of economy. Before we can discuss this aspect a clarification of the meaning of the word "specialization" is necessary.*

In pre-European times there existed in Raroia as elsewhere in Polynesia specialists in the sense that certain individuals were more skilled in the generally known crafts and therefore in addition to their everyday activities also performed work for other members of the community. But if we instead define a specialist as a person who, irrespective of skill, has only one bread-earning occupation and works full time, there were no specialists in ancient times in Raroia.

During the last one hundred years specialists in this latter sense have, however, gradually emerged on the atoll, and we can without exaggeration say that today all the Raroians are specialists, but specialists of only two kinds: copra-growers and traders. The proportion is uneven, with 64 adult (above age of 20) copra growers as compared to two traders, but what is significant is that the persons of both categories all can be regarded as full time professionals.

*For other meanings than the one adopted here see Herskovits, 1953.

An incipient but rapidly growing tendency to a more varied specialization is, however, noticeable and seems intimately connected with the more and more uneven land distribution. As has been shown in Chapter IV certain individuals have for various reasons very little land, and it is especially these landless persons who have tried to find other ways of earning money.

The most common type of such additional part-time work is the transportation of copra sacks from the distant sectors to the central village, where most of the schooners have to load the copra because of the lack of good anchorages in most of the other parts of the lagoon. There are frequent occasions for those who want to take on such work, as many of the Raroians lack adequate canoes and the wealthy land owners usually find it an unnecessary loss of time to do the transporting themselves. The payment is fixed at 25 francs per 50 kg sack, and most of the islanders who engage in this business have canoes which can take 8 sacks each trip. Some of these canoe owners also transport the workers and their families.

Six men regularly undertake transporting of this kind and they all belong to the group of small landholders. Their employers are all among the richest land owners (see further part 1, Chapter VIII).

Another means of eking out the income, resorted to in three cases is to make a sort of coarse doughnuts which are sold at 5 francs apiece. The demand for them is great and the supply never enough as the production limit is usually about 40 doughnuts a day. As a rule a married couple acts as bakers, and they may carry on for as long a time as the whole population is gathered in the village. As this was the case only during the months of July and November-December in 1950, baking could not form a very important extra source of income. The three couples establishing themselves as bakers during these periods, all belong to the class of small landholders, too.

Some men belonging to this class set out at rare intervals to specialize in manufacturing under-water eye-glasses or repair-work of various kinds; but strangely enough nobody has yet seen fit to try out the most natural expedient, often resorted to in Tahiti, of specializing in fishing. It happens that some of the young men go fishing when they are in special need of money, and the fish they bring back are always eagerly bought at good prices by the other islanders. The reason nobody tries in earnest to become a professional fisherman, at least during the months when the whole population is in the village, seems to be the persistence of an old pre-European attitude that fishes are to be distributed as gifts among relatives and important people. Significantly it is never the landless or land-poor individuals who occasionally practice commercial fishing but young men or boys driven by occasional need.

The relation between land-holdings and part time work will be analyzed more closely in the next chapter dealing with the annual income per family.

Chapter VIII

INCOME AND EXPENDITURES

A description of the economic life of the Raroian would not be complete without some information about the differential income and the use made of the money. In spite of the great difficulties in obtaining exact information of this kind for persons who rarely or never keep any books, we have nevertheless tried to gather enough data to be able to discern at least some basic patterns.

The data which we have been able to collect are of the following kinds:

1. The approximate total income during 1950 for each family, with sources of income indicated.

2. Expenditures for a sample group comprising about one third of the total population.

3. The property holdings for each family.

For data on total income we have relied on existing records of sales of copra and mother-of-pearl shells and our own observations supplemented with interrogation of all the family heads. The expenditures for the sample group are taken from the books of one of the storekeepers, and also in this case we have checked with the islanders themselves as much as possible. The list of property holdings, finally, is based on our own systematic survey. The least reliable figures are thus those for the expenditures, but the errors are probably kept at a minimum and the sampling is representative, as will be shown subsequently.

1. Total income.

The income for each family is shown in Table XXIII. From the total sum of 1,923,060 francs, 104,800 shown under the heading "Other activities" must be deducted, as it comes out of the money earned on copra and mother-of-pearl shell diving. The actual income was therefore 1,818,260 francs for the whole population in 1950, or 16,589 francs per capita. With an exchange rate of 64 Pacific francs* to 1 U.S. dollar, this corresponds to 28,410 U.S. dollars for the year and 260 U.S. dollars per capita.

The main source of income is of course the copra. The price varied during the year between 8.35 francs and 11.35 francs a kilo, but in order to simplify our calculations we have used the average price of 10 francs a kilo as a base. The total amount earned on copra (from own and others land) corresponds thus to 169.7 tons. The difference between this figure and the actual output of 187 tons is easily explained by the fact that some of the income from lands in Raroia goes to absent owners.

The income from copra is divided into two categories: that coming from copra grown on own lands and that from preparation of copra for others. The

*All prices in the present study are in Pacific francs. The rate of exchange is 5.50 metropolitan francs to 1 Pacific franc.

Table XXIII: Total income per family during 1950.

Family*	Copra from own lands	Pearl-shell diving	Making copra for others	Transport	Other activities	Total
6	-	-	20,000	4,100	-	24,100
8*	-	-	20,000	8,600	-	28,600
5	-	-	22,000	7,100	6,000	35,100
4*	20,000	-	10,000	-	7,000	37,000
9*	40,000	12,390	-	-	-	52,390
12	50,000	3,360	-	-	-	53,360
11	20,000	-	20,000	8,300	6,000	54,300
3	40,000	9,330	5,000	-	-	54,330
20	20,000	9,540	20,000	-	4,800	54,340
22	40,000	6,120	10,000	-	-	56,120
24	60,000	-	-	-	-	60,000
26	60,000	-	-	-	-	60,000
2	30,000	5,370	20,000	6,200	-	61,570
15*	35,000	-	15,000	700	13,000	63,700
13*	70,000	-	-	-	-	70,000
7	70,000	-	-	-	-	70,000
1*	65,000	7,590	-	-	-	72,590
10	60,000	14,460	-	-	-	74.460
14	75,000	2,490	-	-	-	77,490
21	90,000	-	-	-	-	90,000
27	90,000	-	-	-	-	90,000
18	90,000	1,560	-	-	-	91,560
19*	100,000	-	-	-	-	100,000
17	110,000	-	-	-	8,000	118,000
25	60,000	-	-	-	60,000	120,000
23*	120,000	4,050	-	-	-	124,050
16	130,000	-	-	-	-	130,000
Total	1,545,000	76,260	162,000	35,000	104,800	1,923,060

*For composition of each family, see Table XVIII, Chapter V, part 7.

persons employed in making copra are namely as a rule not full time wage laborers but simply small land holders who occasionally work for the richer islanders, usually one of their distant relatives. The income from the sale of copra thus produced is always equally divided between the worker and the land owner.

If we are to judge solely from the table, there are three families completely without land, but actually No. 5, a couple of "foreigners" working for the part-native storekeeper, is really landless. Families No. 6 and 5 both form households with other related families and always make the copra on certain lands. As they technically are not regarded by their older relatives, from whom they will eventually inherit, as the owners of the land, they are not here classified thus.

As the families in Table XXIII are arranged according to the gradual increase of their income, the relation between the income from own lands and that from other activities is clearly brought out. Evidently only the families with an annual income of 35,000 francs or less find it necessary to earn money in other ways. The apparent exceptions to this: the income of the heads of family No. 17 (8,000 francs) and No. 25 (60,000 francs) are respectively the annual salary of the chief and the supposed annual income of the part-native trader.

The estimate of the trader's annual income is based on the fixed legal percentage of 10% on an annual turnover of 600,000 francs. As he also acts as a money lender, his actual income is probably much higher. The other trader, a Chinese, was not willing to give any details of his activities, and he is therefore not included in the table.

The means of finding additional sources of income - beside the already discussed copra preparation for wealthy land owners - are limited, and actually only two have been tried out to any extent. These are: transport of copra sacks from other parts of the atoll, inaccessible to the schooners, to the central village, and: setting up a bakery (see also Chapter 7, part 3). The only exceptions are the head of the family No. 20, who earned most of his money classified as coming from "Other activities", as a wage worker, and family No. 11, who earned additional money on the sale of ice cubes from a refrigerator.

Whereas all these activities are limited to the families with small land holdings, the diving for mother-of-pearl shell is undertaken by members of families in all income classes. The reason for the even distribution of this income is simply that diving in Raroia, where the lagoon is very deep, requires special skill, which of course is not limited to the lower classes. Considering the small returns (2,742 kgs, worth 76,260 francs), the diving in Raroia must be regarded more as a sport than a professional activity. The situation is of course different during the diving seasons in other atolls, as mentioned in Chapter V, part A.

2. Expenditures of sample families.

None of the islanders keep any record of their expenses, and the only way to get this information was, as we soon realized, to consult the storekeepers' books. At least we could in this way find out what the islanders' expenses were for such things as they regarded as essential themselves - food (canned food, flour and rice), household items (soap, kerosene and gasoline), clothing, cigarettes and some other few miscellaneous items - as the islanders always buy these in the local stores.

Even if we had wanted to, it would have been impossible to gather data of this kind for the whole population as one of the two storekeepers, the Chinese, was not co-operative and besides his books were kept in Chinese. The other, part-native, storekeeper on the contrary gave us without any hesitation permission to copy the accounts, and we used this opportunity to select representative sample families.

Our sample thus obtained comprises 8 families, who regularly made their purchases at the part-native trader's store, and the accounts included cover

two whole months, June, when most of the islanders lived in the village, and August, when they almost all worked in a copra sector. As these families only on rare occasions bought anything from the Chinese storekeeper - who, by the way, carries exactly the same goods as the part-native trader - we can be fairly sure the figures represent the total purchases for these families during the selected months.

The 8 families in our sampling came from the following income classes:

Income class	I Below 35,000	II 36-60,000	III 61-90,000	IV Above 90,000
Total number	3	9	9	6
Number in sample	1	2	3	2

They can thus be said to reflect possible variations in spending habits between the economic classes, if any such variations exist. The composition of these 8 families in respect to relationship, sex and age is as follows:

Family no. 8:	Hu 31, Wi 41, HuMo 65, AdDa 7, AdDa 5
Family no. 4:	Hu 32, Wi 26, AdDa 5
Family no. 9:	Hu 32, Wi 21, WiGrPaSi 58, So 7, Da 1
Family no. 15:	Hu 40, Wi 41, Da 17
Family no. 13:	Hu 42, Wi 37, HuFa 81, So 19, So 18, So 15, Da 10, Da 8
Family no. 1:	Single male 45
Family no. 19:	Hu 46, Wi 35, So 11, So 9
Family no. 23:	Hu 57, Wi 49, So 24, SoWi 16, GrCh 1

Compared to the total population our sampling shows the following characteristics:

Age	MALES			FEMALES		
	Total*	Sample	Per cent	Total*	Sample	Per cent
0 - 14	9	3	30.0	24.5	7	28.5
15 - 29	13.5	4	29.6	12.5	4	32.0
30 - 44	15	5	30.0	11	4	36.3
45 - 59	11	3	27.2	5.5	2	36.3
60 -	3	1	33.3	4	1	25.0
Total	51.5	16	-	57.5	18	-

*As totals the average number of persons present in Raroia during June and August is used. See Chapter II, part 3, Table VII.

The variations in percentages are thus very small among the age groups. In its totality the percentage is for the males 31.6 (16 out of 51.5), for the females 31.1 (18 out of 57.5), and for the whole sample group 31.1 (34 out of 109 persons). The sampling can therefore be regarded as representative of the total population in Raroia.

The figures for the sample group are presented in Table XXIV, and in addition a comparison between income and essential expenses for the same families is made in Table XXV.

If we take these figures as a basis for an estimate of the way the Raroians spend their money, we arrive at the following figures:

The sample group spends 54,255 francs on essential items during two months, which corresponds to an annual expenditure of 325,530 francs. If the expenses were the same proportionally throughout the year for the whole population (109 persons on an average), it should have spent in 1950 1,043,610 francs on essential items, broken down in the following way:

Food	417,476 frs
Cloth	235,898 "
Cigarettes	225,074 "
Miscellaneous	119,159 "
Household	46,892 "
Total	1,044,499 "

As the total income for the whole population was 1,818,260 francs (see part 1), 773,761 francs are unaccounted for. This is, however, not so strange as it seems, as the islanders buy a great amount of articles like planks, cement, corrugated iron and prestige articles of all sorts aboard the schooners or during their visits to Papeete. Our figures are therefore in all likelihood correct, and expressed in percentages the income is spent thus:

Food	23%
Clothing	13%
Cigarettes	12%
Miscellaneous	6%
Household	3%
Surplus	43%
Total	100%

The slight variation among the families as to the expenses for essential items is a little surprising (especially if we remember the different composition of each family), but shows that practically all the islanders have the same idea about what constitutes the minimum necessities for a good living. It is important to note at the same time that all families, even those in the lowest income category, evidently are able to attain this standard. The difference between the families with a small money surplus and those with a big surplus is clearly seen in the amount of money spent on prestige property as will be shown in the next section.

Table XXIV: Expenditures for the sample families during the months of June and August 1950.

Family	Month	Food	Household	Clothing	Cigarettes	Misc.	Total
8	June	682	947	40	549	-	2,218
	Aug.	1,633	46	-	317	491	2,487
4	June	1,350	24	180	105	-	1,659
	Aug.	965	170	200	1,030	389	2,754
9	June	705	130	2,367	917	1,177	5,296
	Aug.	574	-	-	484	543	1,601
15	June	1,276	125	505	330	47	2,287
	Aug.	2,361	55	475	603	315	3,809
13	June	1,199	-	400	970	177	2,746
	Aug.	2,497	66	488	1,441	418	4,910
1	June	403	85	557	331	467	1,843
	Aug.	303	105	-	471	147	1,026
19	June	2,097	181	559	644	508	3,989
	Aug.	1,229	199	60	1,077	120	2,685
23	June	1,482	105	4,755	818	1,053	8,213
	Aug.	2,901	200	1,678	1,614	343	6,736
Total		21,657	2,438	12,264	11,701	6,195	54,255

Table XXV.: Income, expenses and surplus.

Family	Income class	Annual income	Expenses 2 months	Estimated annual expenses	Estimated annual surplus
8	I	28,600	4,705	28,230	370
4	II	37,000	4,413	26,478	10,522
9	II	52,390	6,897	41,382	11,008
15	III	63,700	6,092	36,552	27,148
13	III	70,000	7,656	45,936	24,064
1	III	72,590	2,869	17,214	55,376
19	IV	100,000	6,674	40,044	59,956
23	IV	124,050	14,949	89,694	34,356

Table XXVI. : Property holdings of each family in 1950.

Family* no.	Useful property								Prestige property					
	plank-house	canoe	outboard motor	stove	lamp	sewing machine	refrigerator	radio	bed	chair	table	bureau	wall clock	bicycle
6	1	-	-	-	1	-	-	-	-	-	-	-	1	1
8	-	1	-	-	1	-	-	-	-	-	-	-	-	1
5	-	-	-	1	1	-	-	-	-	-	-	-	-	-
4	-	1	-	-	1	-	-	-	1	1	-	-	-	-
9	-	1	-	1	1	-	-	-	1	-	-	-	-	1
12	1	1	-	-	2	-	-	-	-	-	-	-	-	-
11	1	1	-	2	2	1	1	-	2	4	1	-	1	1
3	1	1	-	-	1	-	-	-	1	-	-	-	-	-
20	-	-	-	-	2	-	-	-	1	-	-	-	-	-
22	1	1	-	1	1	-	-	-	1	1	1	1	1	1
24	1	1	-	1	2	-	-	-	-	-	-	-	-	-
26	1	-	-	-	1	-	-	-	1	-	-	-	-	-
2	-	1	-	1	2	1	-	-	2	2	1	-	-	1
15	1	1	-	1	2	1	-	-	2	4	2	1	1	1
13	1	1	-	-	2	-	-	-	2	-	1	-	1	1
7	1	1	-	2	2	1	-	-	2	6	2	1	1	-
1	1	1	-	2	2	-	-	-	1	3	1	-	-	1
10	1	1	-	2	3	-	-	-	2	2	1	-	1	1
14	2	2	-	2	3	1	-	-	3	6	3	1	1	2
21	2	1	-	3	2	1	-	-	4	8	5	2	2	-
27	1	1	-	2	3	1	-	-	3	7	2	2	1	1
18	1	1	-	2	3	1	-	-	3	7	3	2	2	-
19	-	1	-	2	3	-	-	-	1	-	-	1	-	1
17	1	1	-	3	3	1	-	-	2	6	3	2	1	1
25	2	2	1	4	3	1	1	1	4	14	5	2	3	2
23	1	1	-	2	2	1	-	-	3	2	4	1	1	1
16	1	1	-	2	3	1	-	-	2	6	2	1	1	2

3. Property holdings of each family.

Completely lacking any accurate figures on how the islanders' considerable surplus of money is spent, we have chosen the best possible substitute, namely to make a survey of the property holdings of each family (Table XXVI) which gives us a fairly good idea what the Raroians buy in addition to the articles regarded as essential. We have divided the property holdings into two categories: useful and prestige property. The classifications are evident, except perhaps in the case of the inclusion of bed, chair, table, bureau and bike under the heading "Prestige property." As, however, the furniture is not used - all Raroians still prefer, according to ancient custom, to sleep on pandanus mats on the floor - and there are no roads outside the village for bikes, we think it is correct to designate also these items as primarily intended for the enhancement of the family prestige.

Chapter IX

FOOD CONSUMPTION

A complete investigation of the islanders' food habits and average consumption had necessitated - in order to give reliable results - prolonged and repeated observations of several sample groups during both the work and the rest periods. Unfortunately we did not find time for such a study. The only way to give an indication of what the islanders eat is to use once more the family accounts presented in the preceeding chapter on income and expenses, and try to extract additional information on this aspect. Even if we do not get complete data on the total food consumption in this way, we at least get an idea of the consumption of imported foods.

Among the data on essential items which we found in the storekeeper's account books, those dealing with the purchase of food were complete. As the imported food comes in standard cans or the quantity sold is indicated in each customer's account, we have without difficulty been able to determine the amount of imported food consumed by our sample population during two months.

The monthly and daily consumption per person, based on these figures, together with the corresponding averages for the daily consumption in French Oceania as a whole for 1947 (Jacquier, 1949, p. 601), are presented below. As our sampling is representative (see Chapter VIII, part 2) and comprises one third of the total population, there is all reason to trust the figures.

Table XXVII: Consumption of imported food in grams for sample population.

Food item	Raroia 1950			French Oceania 1947
	Sample population 2 months	Per month per person	Daily per person	Daily per person
Flour	840,000	12,353	411	273
Sugar	157,500	2,316	77	95
Corned beef	79,000	1,162	38	48
Rice	63,000	926	31	65
Coffee	45,000	661	22	-
Biscuit	21,000	308	10	-
Peanut oil	17,600	282	9	9
Canned milk	15,880	233	7	17
Canned fruit	14,175	208	7	-
Canned fish	11,350	167	5	10
Starch	8,000	117	4	-
Canned butter	5,902	87	3	8

Some other imported foods like canned vegetables, tomato sauce, pork and beans, onions and jam can also be bought in the stores, but the islanders consume such negligible quantities of these few items that we have not found it worth while including them in the table. As the only additional food available in the atoll and eaten regularly in such quantities that it can be regarded as constituting a part of the staple diet is fish and coconuts, the islanders' menu is evidently very poorly balanced. We limit, however, ourselves to the data presented above and leave the analysis of them to the specialists.*

In order to get a well-rounded and correct picture of the nutrition problem in its entirety in Raroia, continued field research is necessary, and a complete study of the nutrition and health problems is actually placed very high on the list of additional research we should like to undertake, if we find the opportunity to return once more to Raroia.

*Our knowledge of the nutrition problems will be considerably increased when the results of Miss S. Malcolm's studies in the Tuamotus are available. Miss Malcolm, who is the nutrition specialist of the South Pacific Commission, visited the group in 1953.

Chapter X

CONCLUSIONS

In spite of our fairly intimate knowledge of Raroia, we do not yet feel qualified to interpret correctly all the raw data presented in the present paper. The conclusions in this chapter must therefore not be regarded as definitive in any way, and all we have done here is simply to summarize and comment briefly on the general trends which we think we have discerned.

At the outset, in pre-European times, the islanders subsisted on a simple food-gathering and planting economy, and as far as we know, they had achieved a cultural equilibrium. About one hundred years ago the Raroians came for the first time in more intimate contact with Western culture, and since then the acculturation process has continued with increased intensity.

Due to the isolation and poverty of the atoll, it did, however, not attract foreigners to the same extent as Tahiti, Hawaii, Samoa and other mountainous islands, and the agents of change in Raroia were not representative for our Western society as a whole, but consisted of selected groups, principally traders, missionaries and administrators.

Characteristic for the acculturation process under study is that the changes have been peaceful and that a minimum of pressure has been exercised on the islanders. Raroia is thus a good example of a receiving group, which has been offered a limited number of cultural traits with the freedom to select voluntarily those it wished to take over.

Herskovits has proposed four reasons for a receiving group to adopt foreign traits, and they all seem to have been operative in Raroia. These determinants of change are (Herskovits, 1938, p. 134):

1. Economic advantages
2. Social prestige
3. Congruity of culture-patterns
4. Necessity to adopt traits functionally related with other ones selected for one of the previous reasons.

Of these determinants, number 1 seems to have been the most powerful, as indicated by the radical change from a direct subsistence economy to a preponderantly surplus production. Motive number 4 has certainly also been operative to a large extent and good examples are here the changes in settlement patterns and land ownership correlated with the transformation of the economy.

The prestige factor, number 2, is far from negligible in Raroia, as is clearly shown for instance by the list of the property holdings of each family (Table XXVI). Motive number 3, changes caused by the congruity of culture-patterns between the donor and the receiving group, has certainly played a very small role, and the only field we can think of where it can have had some significance is that of religion.

Let us now turn to the results of the acculturation process. Due to the different ways in which the determinants discussed above have been combined and the relative resistance offered to changes in each case, the impact on the native culture has been very uneven. Some parts of the culture have been more thoroughly changed than others, and the probable order of them, from most to least transformed, is according to our rough estimate the following:

1. Health — The isolation of the atoll in ancient times protected the population against most of the contagious diseases which now occur. Instead of the frequently attested good health in pre-European times, tooth decay and stomach troubles, due to malnutrition are now common.

2. Material culture — European materials and techniques are used almost exclusively, and the only exception is the still frequent use of plaited palm leaves for house construction.

3. Religion — All islanders are practicing Christians, but the widespread belief in magic and the formal-ritual conception of religion are ancient survivals.

4. Economy — European money economy and simple surplus production dominates now, but everybody still devotes some time to fishing, turtle catching, egg collecting and other subsistence activities. It must also be noted that the islanders' surplus economy differs considerably from that usually found in most Western societies as it is a stationary economy.

5. Political organization — Old hereditary chiefs and priests have been replaced by a popularly elected chief and a village council. As the system was fairly democratic already in ancient times, the changes are not so great as they may seem formally.

6. Language — The older generations still speak an almost pure local dialect, but the younger generations use Tahitian to a very large extent.

7. Social organization — As in pre-European times the basic unit is the extended family, even if the size of the family has decreased and the authority of the head is not the same. The old incest rules are applied, adoption is still practiced to a considerable extent, and the kinship-terminology is unchanged. A trend away from collectivism toward individualism is, however, discernable.

8. General knowledge — Most of the islanders are able to write and read Tahitian, but they do not know French. As there are practically no books in the native vernacular and few of the Raroians have any formal education, they do not know much about the modern world in which they are living. Their general outlook is therefore not very different from that of their ancestors.

It is thus evident that the islanders still are in the middle of an acculturation process, and as could be expected, the integration of the various culture traits is very poor. Characteristic for the present situation is that many lags still exist, that the adjustments often are haphazard, and that a new equilibrium has not yet been achieved. The Raroians are lost and bewildered, many times simply because they are between two cultures. They have abandoned too much of their own culture too rapidly, before acquiring new techniques, habits and values.

The islanders have escaped many of the problems other native groups in the Pacific have had to cope with, like over-population, wars, religious competition and material poverty, but there are still reasons for serious apprehension. Some of the difficulties are due to factors outside the islanders' control, like the infiltration of ruthless Chinese traders and the lack of useful books in the native vernacular, but most of the problems have, of course, their root in the above mentioned poor integration of the various culture traits.

These latter problems, which can be traced back to unsatisfactory adjustments to the new situation created by the introduction of foreign economic, religious and political systems, have been discussed in their context in this paper, and we shall only list them briefly here. These principal immediate problems are:

1. Land questions. Much land is uncultivated because of uncertain or disputed titles. Much time is lost in travelling because the land parcels are so small and scattered. Conflicts arise due to poor co-ordination of the activities.

2. Health and nutrition. The islanders do not know how to treat even the most common diseases, and have of course no idea about modern hygiene. The diet is poorly balanced with too much imported and canned food.

3. Social disintegration. The old leaders, who were religiously sanctioned and therefore obeyed, have disappeared, and their places have been taken by traders and office-seekers, who lack authority. No cooperative enterprises are therefore possible any more.

4. One-sidedness of the economy. The islanders are at present fairly wealthy, but all their income derives from mother-of-pearl shell diving or copra preparation, of which only the latter is a regular activity. As there are practically no other sources of income in the atoll, a sudden price fall or disappearance of the copra and shell trade will mean a complete collapse of the present economic system.

In the first three cases, the type of solution - more detailed suggestions are of course outside the scope of the present paper - which seems most logical is simply a continued and better guided Europeanization of the islanders, aiming at the disappearance of partial lags and the achievement of a new equilibrium. Such a solution seems, however, not possible in the fourth case, the one-sidedness of the economy, and the only alternative points instead backwards, to a return to the old subsistence economy.

This solution was actually tried during the depression in the early 1930's, when all trade virtually ceased. It worked out fairly well, and if we are to trust the islanders themselves their health was even improved. The question is, however, whether such a return to the old subsistence economy is still possible, especially as a permanent solution?

The main hindrance is of course that the persons who were the carriers of the old culture and the leaders during the native revival in the early 1930's are now almost all dead, and that the present Raroians have no knowledge of ancient techniques. If such a solution were to be tried once more in the case of the complete collapse of the copra trade, it would therefore certainly be necessary, no matter how ridiculous it may sound, to call in a team of ethnologists and teach the poor islanders survival technique on an atoll, i.e. courses of the same type as those given American airmen at the Bernice P. Bishop Museum during the last war in the Pacific!

Whether two such conflicting principles, as a more complete Europeanization in some cases and a return to the pre-European patterns in other cases, could co-exist is of course an ultimate question which cannot be solved except by practical experiments.

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Part 2

NATIVE TOPOGRAPHICAL TERMS IN RAROIA, TUAMOTUS

by Bengt Danielsson

As the ancestors of the present day natives in the Tuamotu group came from the surrounding mountainous islands, Tahiti, Marquesas and Mangareva, they evidently had to create new terms for most features of the atolls in which they settled. The fact that the Tuamotuans today have a very detailed and exact terminology, which covers almost every topographical feature, can therefore be taken as a proof that 1) they have lived in atolls for long periods, and 2) there was a very intimate relationship between the land and the people.

In Raroia, where all the terms in this paper were collected in 1952, the first conclusion is definitely confirmed by the traditions, which place the discovery and settlement of the atoll at thirty generations from 1950. As to the ecological relationship, it will be treated principally in my forthcoming paper on the economic organization in Raroia, but a short description of the topographical terminology seems warranted here in order to contrast the natives' concepts with those of the modern geologist.

A quick glance at the subsequent lists will show that the native terminology is extremely comprehensive and well suited. In some cases it seems even that the native has a term lacking in the modern scientist's vocabulary which profitably could be borrowed. Let us for instance take the Tuamotuan and pan-Polynesian word motu, which means a part of the reef with vegetation, surrounded by water or dry arid beach rock. The English word islet is frequently used for translating motu, but it does not carry all the important connotations of the latter, i.e., that it may be separated by dry arid beach rock as well as by water, and that it always has some vegetation. Other Tuamotuan terms, which do not have any English counterparts, are: Tahuna, hoa, kapuku and tai, and these are defined in the lists.

This detailed and exact terminology reflects a very close adaptation and utilization of the natural resources, as it was created during the never-ceasing food-quest, which naturally demanded a thorough knowledge of every part of the land, the reef and the lagoon. Another example of how the terminology certainly has grown out of an immediate need, is the classification of the different types of coral patches in the lagoon. There are thousands of coral patches of all sizes and shapes, and the existence of precise and accurate terms for them of course greatly facilitates navigation.

An equally utilitarian attitude is shown in the use of place names. None of the five major islets in Raroia has, for instance, a name, which applies to the whole of it, but different parts and features of them, which are of importance to the natives, are all named. (For convenience, the name of the most known or prominent place has been extended to the whole islet on the map of Raroia in Atoll Research Bulletin No. 31.) Many names for various parts of the lagoon and the reef exist too, which from a Western point of view at first glance seem illogical and unnecessary, but which on closer examination are found to correspond admirably to certain native needs.

The following lists are by no means complete, and are deliberately limited to the terms most frequently in use. It could easily be supplemented through inquiries of older men, who still remember archaic words no longer known to the younger generations. This disappearance of many terms is in itself very illuminating and constitutes a sort of measure of the changes which already have taken place. The former close dependence on the natural resources has to a large extent ceased to exist with the rise of the copra trade and the introduction of a money economy; and in the same way as the names of ancient cult-places now have been completely forgotten due to the natives' conversion to a new faith, certainly most of the topographical terms will also eventually be lost during the continued acculturation process.

The native terms are listed below under the following headings: Parts of the atoll, Directions, Land and reef features, Features of the sea and the lagoon, Coral patches, and Miscellaneous terms.

Parts of the atoll.

Four different parts of the atoll, Raroia, are distinguished and named. The northeastern part is called gake, the southeastern kereteki, the southwestern raro and the northern tokerau. (See map in Atoll Research Bulletin No. 31.) These are not specific names, but general terms, which curiously enough represent two completely different principles of orientation. The words tokerau and raro are compass and wind directions, the former meaning "northeast" and the latter "below the wind." The words gake and kereteki on the other hand indicate the relative position of these parts of the atoll in relation to the principal human settlement. When one stands at the main village facing the lagoon, kereteki is the part of the atoll farthest away to the right, whereas gake is the part farthest away to the left.

This double frame of reference is used all over the Tuamotus, and the underlying principle is still better recognized on other atolls of different shapes and patterns of settlement than Raroia, where due to the general NNE-SSW direction of the atoll, gake and tokerau to some extent overlap. The only explanation for this curious terminology seems to be that it originally was created in an island where it perfectly fitted the geography and human ecology, and then later carried as a part of the general culture to new islands and there for one reason or another preserved.

The compass directions, of which a great number are distinguished by the natives, are as a rule not used for indicating the parts of the atoll, but for determining the wind direction.

Directions and relative positions.

A typically Polynesian way of indicating the relation between two islands or points is with reference to the prevailing trade wind, which most of the year is blowing in the same principal direction, from the east. The island or place situated farthest towards the east and therefore windward, is said to be ruga, above, the other raro, or below. When the natives for instance say that Takume is situated "above" Raroia, this does not mean, as a non-Polynesian observer may suppose, that Takume is the northernmost atoll, but instead that it

is situated slightly closer to the trade wind than Raroia. The name Raroia, or Raro-ia, itself means simply "(the land which) is below (Takume)."

Common terms expressing directions are i uta, towards land, i tua, i tai, towards the sea, and i hopaki, towards the lagoon. A person travelling in a canoe is of course always moving i uta, towards land, either he is coming from the ocean or the lagoon side. A person walking from the lagoon beach towards the outer reef is also moving i uta, until he reaches the center of the islet, and then i tua or i tai - the first term being used if he actually continues out into the sea swimming or by canoe, the second term if he stops before he reaches the edge of the reef. A person walking across the islet in the opposite direction is moving i uta the first half of the distance, and then i hopaki, towards the lagoon. The same terms are also used for indicating the relative position of lands and natural objects.

Land and reef features. (See Figures I and II)

Fenua	atoll, islet or land
Motu	part of the reef with vegetation, surrounded by water or arid dry rock. Literal meaning: "broken off."
Pahere	small part of a motu, united with the main part only through a narrow strip of land
Tahuna	sand dune without vegetation. Literal meaning: "hidden."
Piriatau	indurated sand forming the foundation of a motu
Pakokota	the uncovered beach-rock or island conglomerate
Papa	extremely flat coral platform on the lagoon side
Akau	outer reef flat, covered by water at high tide
Hiti akau	edge of the outer reef flat
Tahora	reef on the lagoon side close to the shore
Papae	edge of the reef on the lagoon side
Koutu	land promontory
Kikiha	wide stretch of the reef between two motu, covered by water at high tide
Ava	pass, deep and wide channel in the reef circle
Hoa	shallow channel beginning on the lagoon side, separating completely or partially two motu
Tairua	closed hoa

Poehoga	inner part of a closed hoa
Kaoa	reef spur on the lagoon side
Tauta	reef spur on the sea side
Koehae	surge channel on the outer reef
Repa	open gap in the outer reef flat where the sea reaches the shore
Puta	opening in the lagoon reef
Mapuna	blow holes on the outer reef
Patuarea	spur on the sea side slightly higher than the surrounding reef
Paepae	upper part of the lagoon beach
Paraha	the part of the sandy lagoon beach intermittently wet by the swash

Features of the sea and the lagoon.

Roto, Tairoto	lagoon
Tai	the sea from the beach to the edge of the reef
Tua	the sea beyond the edge of the reef
Moana	deep, blue water, either in ocean or lagoom
Au	current
Reva	depth
Rokaroka	abyssmal depth
Kare	wave
Garu	breaker
Miti	salt water

Coral patches. (See Figure III)

Purari	isolated patch
Vata	group of patches

Tohitikia	patch rising up from the bottom in the form of a cylinder or slightly marked cone
Patahora	mushroom-formed patch
Magarua	U-shaped when seen from above
Karena	patch which reaches the surface, big size
Puteu, teu	patch which reaches the surface, but of smaller size
Tirare	patch not reaching the surface, but still visible
Marahi	still visible, but lower than tirare
Kapuku	patches on the bottom, not visible from the surface

Miscellaneous terms.

Ahu	sand bank on the bottom
Puratea	same, but of smaller size
Patetea	same, but of still smaller size
Konao	coral stone
Gaere	sand

FIG I TERMS FOR LAND AND REEF FEATURES.

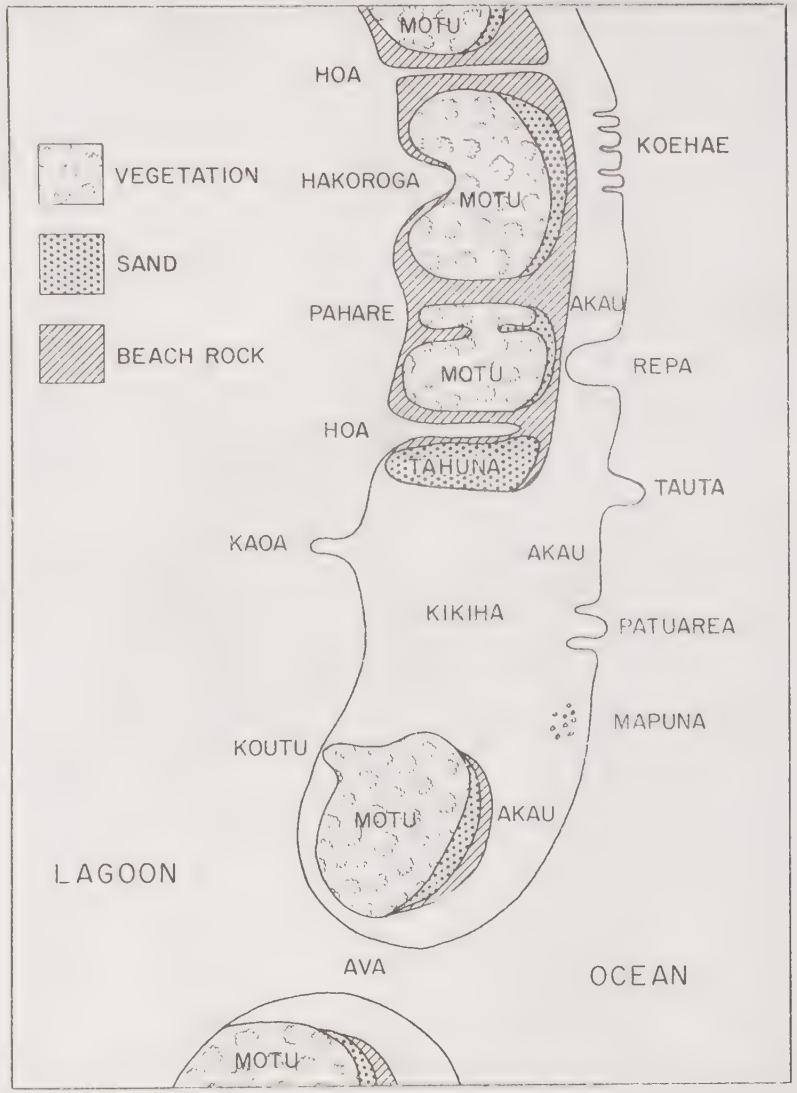


FIG II TERMS FOR LAND AND REEF FEATURES

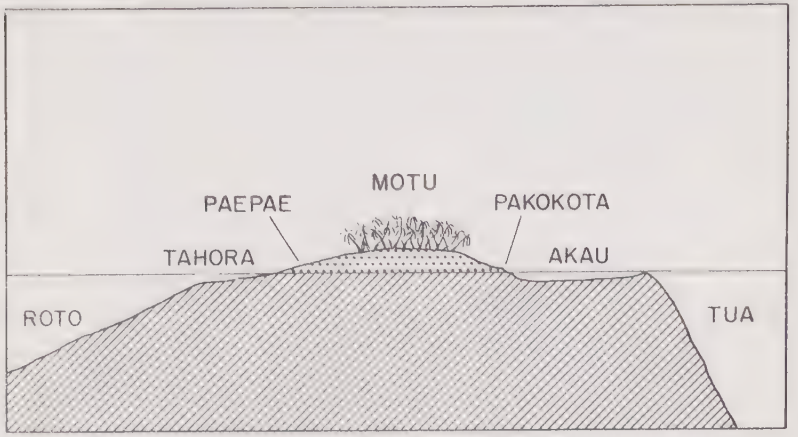
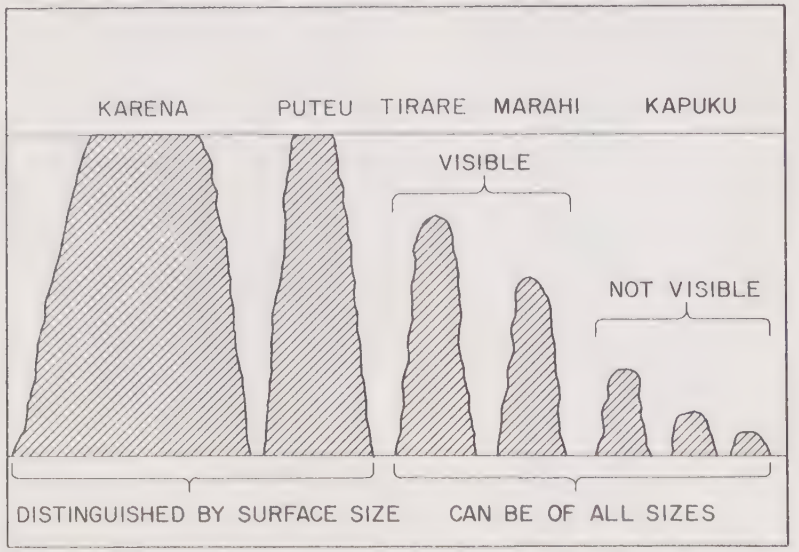


FIG. III TERMS FOR CORAL PATCHES



Part 3

NATIVE TERMINOLOGY OF THE COCONUT PALM IN RAROIA ATOLL[1/]

by Bengt Danielsson

The importance of the coconut palm to the natives is reflected by the detailed terminology. Every part of the tree is given a specific name, and the different stages of development of the nut are distinguished with an almost scientific accuracy. At least a dozen varieties are known to the islanders and used according to their special properties.

Stages of growth.

The usual word for the palm tree is hakari, but niu, the older word of pan-Polynesian distribution, is also known. Only a full-grown tree is called hakari, however, and before it reaches this stage three distinct names are used. Nana is a very young plant with sprouts not yet split into leaflets. The roots are short and the mesocarp or husk is still attached to the sprout. At the next stage, tikovai, the leaves are fully developed, 6-10 feet high, and emerge like a fan from the ground. Gradually the trunk is formed, and from the moment it can properly be called a tree, it is termed hoka. At the age of six or seven years finally, the tree reaches maturity and is a hakari.

The parts of the tree.

The terms for the different parts of the full-grown tree are very numerous. To begin with the roots, these are called aka, which simply is the generic name for root. The lower, thicker part of the trunk is called turei, and the rest of it tumu. The upper part of the stem, the vegetative bud, which is edible, is named muko.

A young undeveloped leaf still folded against the midrib has a special name, mote, in contrast to the fully developed leaf for which two words are used, rauniu or gaofe. The first word is the pan-Polynesian term and the second the local term. Both are curiously enough also used for the smaller leaflets attached to the central midrib, the katakata. The term for the midrib of the leaflet is koitika.

The parts of the fully developed flower and their names are shown in Figure 1. A flower bud is called kumoa, but there is no word for the fully developed flower cluster as a whole.

The nut.

All features of the nut, even the smallest and most insignificant from a Western point of view, are recognized and named by the natives. They are shown in Figure 2.

As everywhere in Polynesia several well defined stages in the growth of the nut are distinguished and in Raroia their number is five. No common term

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1/ The terminology varies considerably in many cases from atoll to atoll. We have limited ourselves to that in use in Raroia.

for "nut" exists. This is a typical example of the strictly utilitarian attitude of the islanders. Each type of nut has its own properties, useful in different ways and accordingly each has a special name. A "nut in general", on the other hand, combining in an abstract the way the qualities of several types of nuts, is of no use whatsoever, and no such term has therefore been created.

The names and principal characteristics of the nut at the different stages are as follows:

Stage of growth	Characteristics
Puriri	Recently formed nut, no cavity inside.
Rehi	Almost full size but still green nut. Cavity filled with bitter water. No or very little flesh formed.
Viavia	Full size but still green nut. Thin slimy flesh. Water slightly sweet.
Komoto	Full size nut with spots of darker color. Flesh thick and firm. Water effervescent and bitter.
Gora	Maximum size, brown nut. Flesh of maximum thickness. Water sour.

Varieties.

The natives distinguish at least a dozen varieties of coconut palms, but it is doubtful whether the distinctions are all justified from the point of view of a scientific botanist. The distinctions are based on the following classificatory principles: color of nuts, arrangement of nuts, and special properties of nuts.

Varieties based on the color of the nuts:

mamagu	dark green nuts
motea	pale green nuts
fateka	light yellow-green nuts
koheko heheko	reddish-brown nuts
kurakura	reddish nuts
heru	nuts of which the upper part is scarlet-colored

RAROIAN NAMES OF COCONUT PARTS

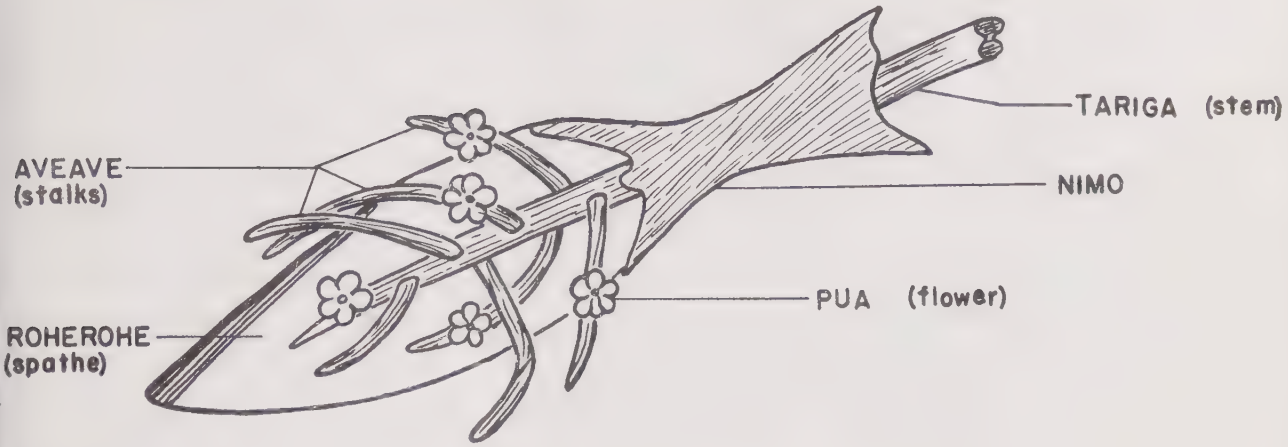
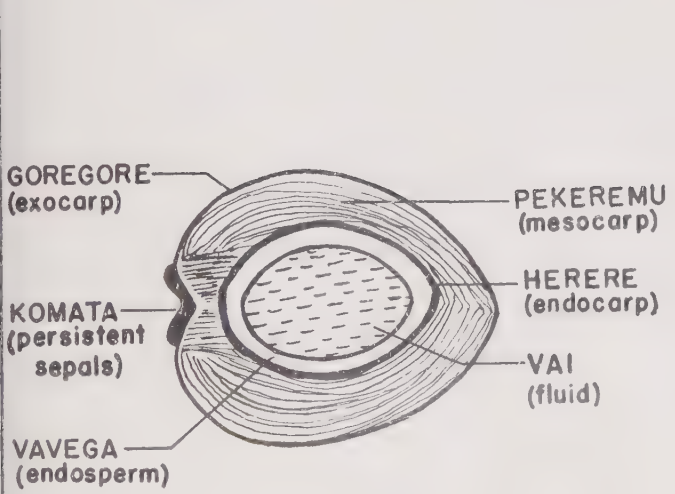
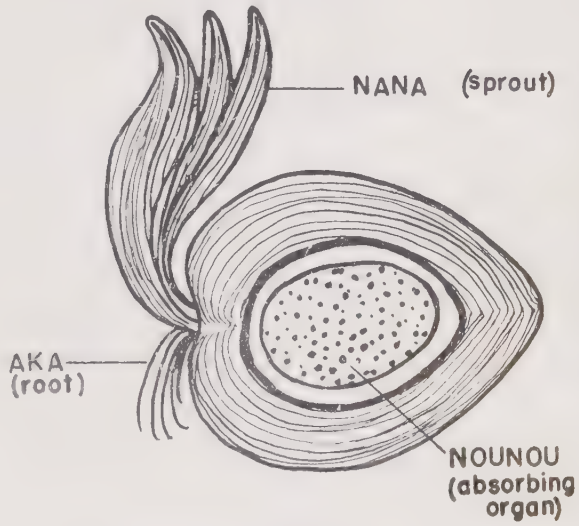


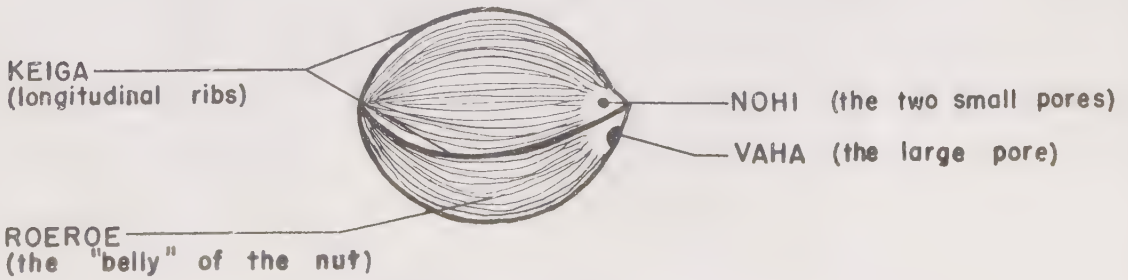
FIGURE 1. FLOWER STEM AND SPATHE



(a) CROSS SECTION OF MATURE NUT



(b) CROSS SECTION OF SPROUTING NUT



(c) HUSKED NUT

FIGURE 2. NUT

Varieties based on the arrangement of nuts:

takaveatika	the nuts lack stalks and are attached directly to the stem
makire	abundant, small nuts in thick grape-like clusters

Varieties based on special properties of nuts:

kaipoa	nut with edible, sweet husk or mesocarp
pururoa	nuts with thick husk and small nuts
karava	oval nuts with long husk fibers

Miscellaneous.

The following miscellaneous terms were recorded:

nounou	absorbing organ (haustorium) in a gora or full-grown nut
koka	oily nounou
puha	gora with dry detached meat
kivako vavako	gora without water or nounou
kovari	prematurely fallen nut
kererau	cluster of nuts
popoga	flesh attacked by insects, or deteriorated in other ways

Final note.

The terms given in this short paper are those still commonly used in the atoll. Some of the older informants could give a certain number of additional terms, which now have become obsolete due to the introduction of factory-made products replacing articles formerly made of the various parts of the palm. As we are mainly interested in the present situation, however, and our lists at any rate contain the native words for all the main features of the palm tree, we have not included these additional and more doubtful terms.

Part 4

BIRD NAMES IN RAROIA ATOLL

by Bengt Danielsson and Aurore Natua

Type	Scientific Name	English Name	Raroian Name
Res.	Anous minutus minutus	white-capped noddy	Kikiriri
Res.	Anous stolidus pileatus	brown noddy	Goio
Res.	Conopoderas atypha atypha	reed warbler	Kokikokiko, kotiotio, Makomako, Komakomako
Res.	Demigretta sacra sacra	reef heron	Kotuku
Res.	Fregata sp.	man-o-war bird	Kotaha
	ariel	white breast	Puhoho
	"	two white spots on the sides	Makino
	minor	white head and breast	Rutu
	"	red throat	Varovaro
Res.	Gygis alba candida	fairy or white tern	Kirarahu, Kitaketake
Res.	Heteroscelus incanus	wandering tattler	Kuriri
Res.	Procelsterna cerulea teretirostris	blue ternlet	Gaga
Res.	Sterna fuscata oahuensis	sooty tern	Kaveka
Res.	Thalasseus bergii cristatus	crested tern	Tara
Res.	Sterna lunata	spectacled tern	Oreore
Res.	Sula leucogastra plotus	brown booby	Kariga
Res.	Sula sula rubripes	redfooted booby	Kariga hopetea

Type	Scientific Name	English Name	Raroian name
Migr.	Urodynamis taitensis	long-tailed cuckoo	Kurevareva, karevareva
Migr.	Numenius tahitiensis	bristle thighed curlew	Kivi, keufea
Migr.	Phaethon lepturus dorotheae	white-tailed tropic bird	Tavake hopetea
Migr.	Phaethon rubricaudra	red-tailed tropic bird	Tavake hopekura
Migr.	Pluvialis dominica fulva	Pacific golden plover	Torea
Migr.	Puffinis nativitatus	brown shear-water	Rako
Migr.	Puffinis Pacificus	black shear-water	Pugapuga
Former Res. now ext.	Aechmorhynchus parvirostris	Polynesian sandpiper	Titi
Former Res. now ext.	Porzana tabuensis	little rail	Moho
Former Res. now ext.	Ptilinopus coralensis	fruit dove	Koko

Part 5

CHECK LIST OF THE NATIVE NAMES OF FISHES FOR RAROIA ATOLL

by Bengt Danielsson

The following list in the first column apparently includes all the names for fishes that the Raroians know. The terms preceded by an asterisk were checked by the authors against specimens collected on the 1952 Coral Atoll Project at Raroia Atoll, Tuamotu Archipelago, and identified in the field. The second column includes these tentative field identifications which will have to be confirmed by additional study. The third column includes the general common name for the fish group involved. For further information on the fishes collected at Raroia see Atoll Research Bulletin No. 18.

The Raroia names are almost always the same as those used throughout the Tuamotus, but there is a strong tendency for Tahitian terms to supplant the original fish vocabulary in the western Tuamotuan islands. Of the 176 native names, 37 could not be confirmed by fishes collected on the Coral Atoll Project.

Alphabetical list according to Raroia name:

Raroian name	Scientific name	General English name
* AHORE	Kuhlia sandwichensis	ahole
* AKEGA	Acanthurus triostegus	surgeon fish
AUHOPO	Euthynnus pelamis	bonito
* AVAI	Acanthurus nigricans	surgeon fish
FAFARUA	Ray	ray
* FAKETA	Epinephelus tauvina	sea bass
* FANEA	Hemirhamphus pacificus	half beak
* GAREA	Epinephelus merra	sea bass
* GAVERE	Scarus pulchellus	parrot fish
GUHURI	Carangidae	jack or crevalla
HAKURA	Xiphias gladius	swordfish
* HAMI	Ctenochaetus strigosus	surgeon fish
* HAPUTU	Cephalopholis argus	sea bass
* HAUEKE	Scarus sp. two	parrot fish

Raroian name	Scientific name	General English name
HAUREPE	Istiophorus	sail fish
HEIMIKI	Lutjanidae	snapper
HEREPOTI	Acanthuridae	surgeon fish
* HIMIKI	Lethrinidae	snapper
* HOKAHOKA	Variola louti	sea bass
HOKE		
* HOMOHOMO	Scarus sp. seven	parrot fish
* HOPIRO	Mugil vaigiensis	mullet
* HOPUPU	Melichthys buniva	trigger fish
* HOROTAHORA	Balistapus aculeatus	trigger fish
* HUE	Tetrodon meleagris, Canthigaster cinctus, C. solandri, C. bennettii.	puffer fish
* HUTIHUTI	Lutjanus kasmira	snapper
* KACU	Belone platyura	needle gar
KAKAHI	Germo macropterus	tuna
* KAKARIURI	Echeneis naucrates	remora
* KAKAVERE TUPOUPOU	Aulostomus chinensis	trumpet fish
* KANAE	Mugil crenilabis	mullet
KAPUHA	Mullidae	goat fish
* KARAEA	Synodus variegatus, Parapercis tetracanthus	lizard fish
* KARAUA	Naso tuberosus	unicorn fish
* KARAVA	Balistes undulatus, Cantherines pardalis	trigger fish
* KAVATA	Mugil engeli	mullet
* KAVETI	Parupeneus trifasciatus	goat fish

Raroian name	Scientific name	General English name
* KEKE	Chaetodon facula	butterfly fish
* KIKITO	Acanthurus guttatus	surgeon fish
* KIOA	Holocentrus opercularis	squirrel fish
* KIOKIO	Albula vulpes	bonefish
* KITO	Epinephelus maculatus	sea bass
* KOFARUFARU	Epinephelus maculatus	sea bass
* KOKIRI	Balistidae in general	trigger fish
KOKOPU		
* KOKOROHUE	Blenniidae (in toto)	blenny
* KOKOTIKA	Ephinephelus socialis	sea bass
KOMENE	Selar crumenophtholmnus	jack or crevalla
KOMURI	Carangidae	jack or crevalla
* KONIHO	Scarus sp. one	parrot fish
KOPA	Holocentridae	squirrel fish
* KOPAHOPAHO	Pseudoscarus troschelli, Scarus microrhinos	parrot fish
* KOPARIPARI	Tetrodon meleagris	puffer fish
* KOPERU	Decapterus sanctae-helenae	jack or crevalla
* KOPUMERI	Scarus forsteri, Scarus sp. one.	parrot fish
* KORAI	Megaprotopon, Chaetodon in general	butterfly fish
* KORAIMU	Chaetodon lunula	butterfly fish
* KOTIMU	Abudefduf sexfasciatus, A. septemfasciatus, A. sordidus	demoiselle fish
KOUKA	Croyphaena	dolphin
* KOUMA	Mullidae	goatfish

Raroian name	Scientific name	General English name
* KOVIKOVI	Chaetodon ephippium	butterfly fish
* KUKINA	Scarus sp. two	parrot fish
* KUO	Mulloidichthys auriflamma	goat fish
* KUREVAREVA	Balistidae	trigger fish
* KURIPO	Naso sp.	unicorn fish
* KUTARO	Balistes fuscus	trigger fish
KUTEUTEU	Carangidae	jack or crevalla
* KUTU	Scarus sp. eight	parrot fish
MAERE	Variola louti	sea bass
* MAGUMAGU	Lutjanidae	snapper
* MAHEKO	Balistidae	trigger fish
MAHIMAHI	Coryphaena	dolphin
* MAKERE	Scarus sp. nine	parrot fish
* MAKIAMO	Mullidae	goat fish
* MAMO	Pomacentridae	demoiselle fish
MANA	(?) Gempylidae	? oil fish
* MARAIA	Cheilinus undulatus	wrasse
MARAPE	Scaridae	parrot fish
* MARARI	Thalassoma umbrostigma Novaculichthys taeniourus	wrasse
* MARAVA	Siganus sp.	
MAREA	Acanthuridae	surgeon fish
MAROTO	Cypselurus sp.	flying fish
* MEKO	Lethrinus rostratus	snapper
* MEROMERO	Epinephelus bohar	sea bass
* MOAGA	Parupeneus bifasciatus	goat fish

Raroian name	Scientific name	General English name
* MOI	Polydactylus sexfilis	threadfin
* MORORI	Tetrodon meleagris	puffer fish
* MU	Monotaxis grandoculis	mu
MUMU	Acanthuridae	surgeon fish
* NAENAE	Caranx armatus	jack or crevalla
NAKO	Mullidae	goat fish
NANUE	Acanthuridae	surgeon fish
* NIFA	Albula vulpes	bonefish
* NOGA	Scarus forsteri, Scarus sp. three	parrot fish
* ONO	Sphyraena snodgrassi	barracuda
* OROHEA	Acanthurus elongatus	surgeon fish
* PAGO	Balistes sp. one	trigger fish
* PAKERERO	Zebrasoma veliferum	sailfin surgeon fish
* PAKEVA	Caranx ferdu	jack or crevalla
* PAKOU	Thalassoma, Stethojulis phekadopleura	wrasse
* PAKURAKURA	Acanthurus achilles	surgeon fish
* PANAPANA	Zanclus cornutus	moorish idol
* PAPARARI	Scarus, Gomphosus	parrot fish, wrasse
* PAPURAGO	Myripristis murdjan	squirrel fish
* PARAI	Lutjanus marginatus, L. monostigma	snapper
* PARATUKI	Cirrhitus pinnulatus, Cirrhitidae	hawk fish
* PARUKU	Caranx melampygus	jack or crevalla
* PATI	Albula vulpes	bone fish

Raroian name	Scientific name	General English name
* PATIKI	Bothus pantherinus	flat fish
* PEPE	Caranx adscensionis	jack or crevalla
* PETI	Myripristis murdjan	squirrel fish
* PETIMU	Myripristis adustus	squirrel fish
* PIHERERE	Spratelloides sp. one	herring
* PIRIREHI	Bothus pantherinus	flat fish
* PITIKA	Scaridae	parrot fish
* POPOGA	Balistes vidua	trigger fish
* POTAKA	Ray	
* PUAGARI	Scarus sp. ten	parrot fish
* PUAKI	Lutjanus marginatus	snapper
* PUGAPUGA	Synancea verrucosa	stone fish
* " veve	Scorpaenopsis gibbosus	stone fish
* RAI	Scomberoides sancti-petri	leatherback
* REREIOGA	Caranx speciosus	jack or crevalla
ROEROE	Elagatis bipinnulatus	rainbow runner
* ROI	Cephalopholis argus	sea bass
* ROROA	Acanthocybium solandri	wahoo
* RUHI	Caranx adscensionis	jack or crevalla
* RUKERUKE	Holotrachys spinifer	squirrel fish
* RUPO	Caranx melampygus	jack or crevalla
* TAEA	Lutjanus sp. one	snapper
* TAGAU	Epinephelus bohar	sea bass
* TAHAKARI	Apharius furcatus, Kyphosus sp. one	snapper
* TAKIRE	Parupeneus barberinus	goat fish

Raroian name	Scientific name	General English name
* TAMURE	Lethrinus mahsena	snapper
TAPATAI	Alectis ciliaris	thread fish
* TAPERETA	Ray	ray
* TAPIRO	Cheilinus undulatus	wrasse
TAREFA	Aprion virescens	snapper
* TAREI	Naso lituratus	unicorn fish
* TATAHAUTA	Caranx melampygus	jack or crevalla
* TATARAIHAU	Scorpaenodes sp. one, Pterois volitans	scorpion or turkey fish
* TATATATA	Epinephelus bohar	sea bass
* TATIHI	Naso eoume	unicorn fish
* TATIKA	Cheilinus undulatus	wrasse
TAUTE	Scaridae	parrot fish
* TEGATEGA	Scarus microrhinos	parrot fish
* TEMU	Holocentrus caudimaculatus	squirrel fish
* TERO	Lutjanus marginatus	snapper
* TIGITIGIA	Holocentrus sammara, H. laevis	squirrel fish
* TIKAMU	Chaetodon lunula	butterfly fish
* TIKEKE	Holocentrus binotatus	squirrel fish
* TIKEI	Holocentrus microstomus	squirrel fish
* TIKEIKEI	Holocentrus diadema	squirrel fish
TIPA		
TIPUKUPUKU	Echeneididae	remora
* TITEKETEKE	Scaridae	parrot fish
* TITIRIRI	Epinephelus maculatus	sea bass
* TOHARE	Lutjanus kasmira	snapper

Raroian name	Scientific name	General English name
TOHEVERI	Euthynnus pelamis	bonito
* TOKATI	Scarus formosus	parrot fish
* TONAE	Pseudoscarus troschelli Scarus microrhinos	parrot fish
* TONU	Paracanthistius maculatus	sea bass
* TOPIROPIRO	Epibulus insidiator	wrasse
* TOTARA	Diodon hystrix	porcupine fish
* TOTOKE	Scarus sp. six	parrot fish
TOTOVIRI	Belonidae	needle gar
* TUATAU	Sphyraena helleri	barracuda
* TUGOUGOU	Epinephelus sp. one	sea bass
* TUTUKE	Ostracion sebae, O. lentiginosum	box fish box
* UME	Naso annulatus	unicorn fish
* UOA	Myxus leuciscus	mullet
URAVENA	(?) Ruvettus pretiosus	? oil fish
URUA	Carangidae	jack or crevalla
* URUAKAU	Diodon hystrix	porcupine fish
VAU	Germo	tuna
* VETE	Mulloidichthys samoensis	goat fish
* VEVE	Epinephelus hexagonatus	sea bass